MEP SUCCESSES: A CASE STUDY APPROACH

MANUFACTURING EXTENSION PARTNERSHIP

NIST Special Publication 916

United States Department of Commerce • Technology Administration • National Institute of Standards and Technology

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Manufactucturing Extension Partnership
National Institute of Standards and Technology
Gaithersburg, MD 20899-0001

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PREFACE

This compendium of 24 case studies was developed through the cooperative effort of individuals from across the country who work at, or are directly affiliated with, 17 manufacturing extension centers. All 17 are members of the Manufacturing Extension Partnership (MEP), a national network of manufacturing extension centers in all 50 states and Puerto Rico whose collective mission is to improve the global competitiveness of small and medium-sized U.S. manufacturers. MEP is supported and coordinated by the National Institute of Standards and Technology.

Nothing describes the value of MEP assistance better than stories of our client interactions. This collection captures the daily "nuts and bolts" activity of MEP field engineers, the wide variety of services the program offers and the major improvements in competitiveness of client firms that MEP assistance can produce.

For more information, or to contact the MEP center serving your area, call 1-800-MEP-4MFG. NIST MEP in Gaithersburg, MD, the program's headquarters, can be contacted at 301-975-5020, or via our website at http://www.mep.nist.gov/.

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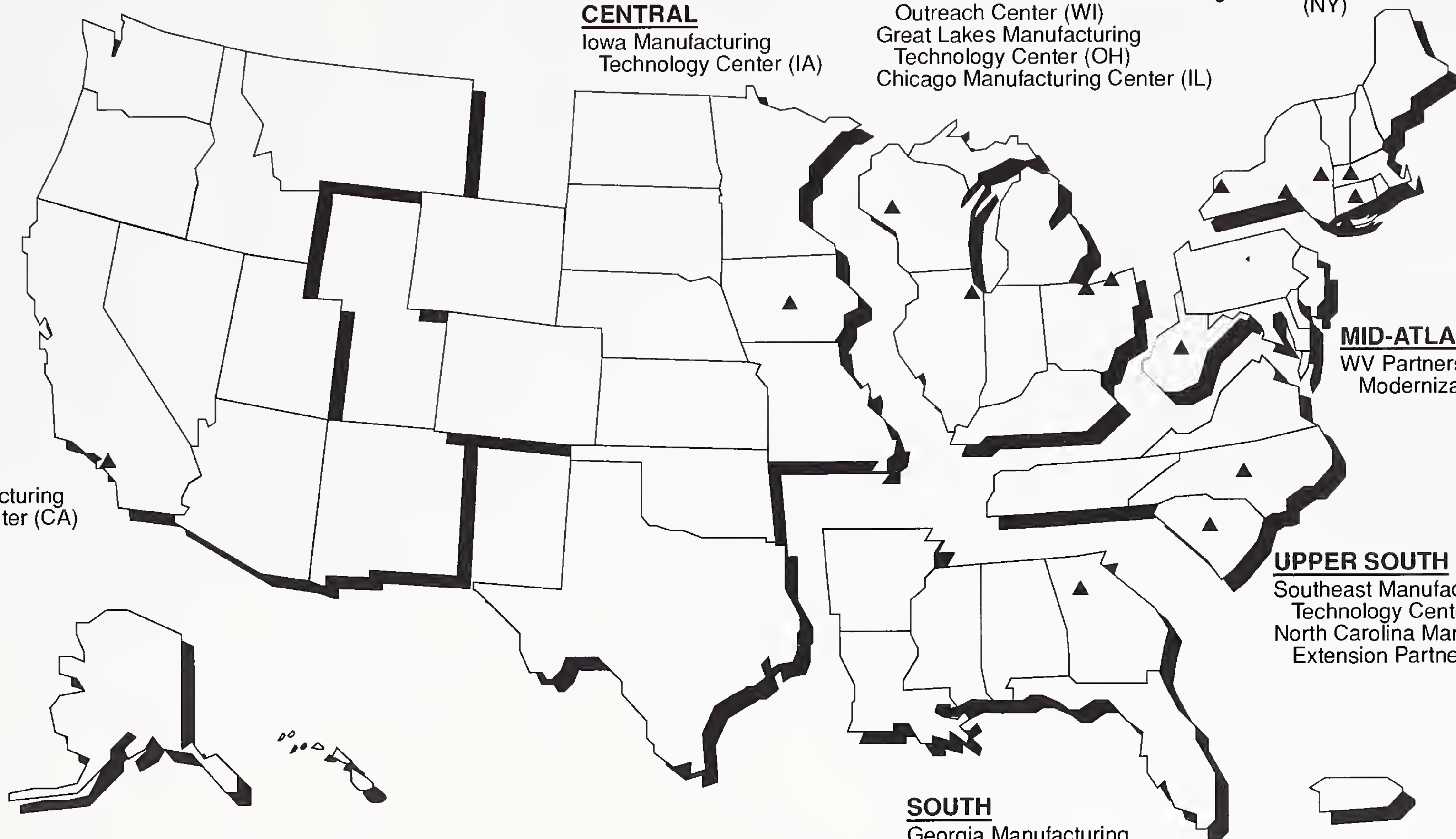

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PRODUCT DEVELOPMENT

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QUALITY ASSURANCE

SKILLS TRAINING

WORKFLOW ANALYSIS

P R O F · I L E S

Georgia Institute of Technology, Georgia Manufacturing Extension Alliance (GMEA)
Atlanta, Ga.

Baron Industries Corporation, Dalton, Ga.

Manufacturer of glass range tops

Number of employees: 50

Based on the case by Jan Youtie, Economic Development Institute, Georgia Institute of Technology, on behalf of GMEA.

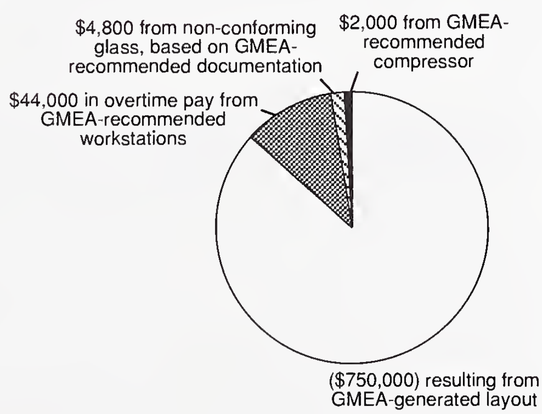
Projects

Plant layout assistance to Baron Industries Corporation. GMEA provided approximately 105 hours of assistance to Baron Industries Corporation, which included activities related to designing a new plant layout and setting up demonstrations of manufacturing and business management software and barcode technologies. GMEA made several additional recommendations to improve Baron's work processes.

Selected outcomes:

Recommendations adopted by Baron resulted in savings of more than $800,000 in inventory, overtime pay, and equipment and materials. The new GMEA-recommended layout prompted an inventory decrease that produced a one-time savings of $750,000, and incorporated process improvements that netted a 40-percent increase in direct labor productivity in several of Baron's product lines. The addition of a new workstation saved the company $44,000 in overtime pay, with a further $100,000 savings expected over the course of a year. Skills learned by Baron management in a GMEA documentation course helped reduce the company's internal scrap rate from 80 percent to 10 percent, saving it $5,000 over a three-week period. Finally, Baron was able to use the computer-generated layout to close an $8 million sale and to justify the addition of 16 new jobs.

Cost Savings from GMEA Related Activities



SUCCESS STORY

Industrial Technology Assistance Corporation (ITAC)
New York, N.Y.

Braunstein, Inc., New York, N.Y.

Manufacturer of fine gold jewelry

Number of employees: 110

Based on the case by Claire Brownstein, ITAC

Project(s):

Productivity improvement and skills training. In 1992–1993, ITAC assessed Braunstein's manufacturing operation and recommended a comprehensive productivity improvement project to improve worker efficiency, product quality, reduce costs, and formalize processes. ITAC identified a consultant specializing in the jewelry business to be the lead assistance provider, and assisted the company to engage and manage the consultant. ITAC also helped the firm obtain a grant from the New York State Industrial Effectiveness program (IEP) to offset partially the project cost. In 1995–96, ITAC developed and managed a 50-hour skills training program to improve and upgrade the skills of 15 new hires.

Selected outcomes:

Braunstein experienced significant manufacturing improvements within one year of completing the productivity initiative. Individual employee productivity tripled. Cycle time was reduced 20 percent, and reject rates decreased from 10 percent to 6 percent. Overall quality improved an estimated 15–20 percent, while increased efficiency reduced operating costs by 25–75 percent—depending on the specific function. Greater use of capacity also resulted. For example, Braunstein does all of its stamping in house, as opposed to only 60 percent before the initiative. The ratio, in percent, of imported to manufactured products has also improved—from 65:35 to 50:50. Improved product design and delivery has helped to increase Braunstein's customer base, and the company has hired 20–25 new plant workers and retained almost 50 manufacturing jobs as a direct result of improved and expanded operations.

Impacts of Manufacturing Improvements

	Before improvements	After improvements
Cycle time	5 weeks	4 weeks
Customer reject rate	10 percent	6 percent
In-house stamping	60 percent	100 percent
Percent ratio of imported to manufactured products	65:35	50:50

SUCCESS STORY

Western New York Technology Development Center, Inc. (WNYTDC)
Amherst, N.Y.

Buerk Tool and Machine Co., Inc. (Buerk), Buffalo, N.Y.

Manufacturer of machine parts and tools

Number of employees: 14

Based on the case by Sue Scherred Western New York TDC and Douglas Welch, Nexus Associates

Project(s):

Technical assistance project involving comprehensive plant layout and workflow analysis. TDC helped Buerk implement several process and layout improvements. Optimization models demonstrated alternative layout schemes that rendered more efficient workflows. Other recommendations to improve Buerk's production area dealt with housekeeping procedures, tool and materials storage, and better use of floor area. New work tracking software linked the shop floor and offices.

Selected Outcomes:

Through TDC, Buerk gained a new capacity for change, learning that new practices are desirable, possible, and profitable. Employees also profited by receiving a 15-percent bonus and a 5-percent wage increase. Work-in-progress inventory declined, and better housekeeping procedures improved workflow. Sales for the company increased by 20 percent to a record $1.4 million. Process flow improvements reduced significantly the physical distance materials move during the production process, thus reducing cost and increasing delivery speed to customers. The new plant layout further generated space-related savings totaling around $6,800.

Project-Related Improvements and Economic Impacts

- Increased sales (by 20 percent to $1.4 million)
- 15 percent bonus and 5 percent wage increase for employees
- Process flow improvements
- 30 percent reduction in production movement
- More efficient use of space

SUCCESS STORY

Iowa Manufacturing Technology Center (MTC), Ames, Iowa

Carver Pump Company (Carver), Muscatine, Iowa

Manufacturer of standard and custom pumps for commercial and military markets

Number of employees: 126

Based on the case by Jan Youtie Economic Development Institute, Georgia Institute of Technology, on behalf of Iowa MTC

Projects:

Technical assistance to complete ISO certification process. Iowa MTC engineers provided 250 hours of assistance to help Carver become certified to the ISO-9001 standard and thereby increase sales to commercial and export markets. Project work towards this end included interpreting ISO specifications, providing a gap analysis, arranging visits with other certified manufacturers, and providing company training and a pre-assessment audit.

Selected outcomes:

Carver's sales composition changed dramatically following ISO certification. Seventy percent of Carver's sales now come from commercial clients and 30 percent from defense-related customers, the reverse of its historical pattern. Carver also expects export sales, now at 5 percent, to rise to 15 percent in the near future. These changes have enabled it to maintain sales stability in the face of a 40-percent decline in orders from key military customers. New business with a commercial client—Westinghouse Electric Corporation—gave the company $70,000 in new sales, a level expected to rise to $300,000 or more. The company also received its first export business for nearly $200,000 worth of orders for turbine pumps from an Italian manufacturer. Finally, through training, Carver staff gained new skills and strengthened communications throughout the company.

Benefits Resulting From ISO Certification

Benefit	Before Assistance	After ISO Certification
Training	Virtually no formal training	$20,000 investment in ISO-related training
Commercial sales	30 percent commercial 70 percent defense-related	70 percent commercial 30 percent defense-related
Export sales	Virtually no export sales	5 percent export sales

California Manufacturing Technology Center (CMTC)
Hawthorne, CA

Century Aero Products International, Inc. (CAP), Compton, CA

Manufacturer of airplane luggage containers

Number of employees: 50

Based on the case by Greg Rosen, NIST MEP, on behalf of the California Manufacturing Technology Center

Project(s):

Engineering assistance with proposal to create new container for FAA solicitation. A field engineer at CMTC helped CAP win an FAA solicitation to design a cost-effective, bomb-resistant container. He selected manufacturing partners to work with CAP, and arranged for product and materials analyses at a federal government lab. He also collected and analyzed past test results from similar CAP products. Finally, the CMTC engineer collaborated with CAP in developing the proposal to the FAA and acted as project manager as CAP developed prototypes of this new container.

Selected outcomes:

CAP's winning proposal will enable it to sell $1.5 million worth of airline containers to the FAA. CAP predicts total container sales of $20-$40 million in the next 5 years, with a possibility of reaching $50 million if the FAA requires retrofitting of planes. CAP's new bomb-resistant container will enhance air safety and—because it is lightweight—will be easier for airlines to purchase and use.

Impacts of California MTC's Assistance

- Sales of $1.5 million to FAA.
- Likelihood of $20-$40 million in sales over the next five years.
- Future potential sales of up to $50 million.
- Enhanced air safety.

SUCCESS STORY

Southeast Manufacturing Technology Center (SMTC)
Columbia, S.C.

Cheraw Yarn Mills, Inc. (Cheraw), Cheraw, S.C.

Manufacturer of small thread and sales yarn

Number of employees: 275

Based on the case by English Drews, SMTC

Project(s):

Assistance in attaining ISO-9002 certification. SMTC assisted Cheraw through a variety of projects designed to help it become certified to the ISO-9002 standard. Projects included providing training to supervisors and employees, assisting in documenting procedures, establishing best practices, and conducting internal audits and improvement plans based on audit results. Cheraw completed all phases of a five-part process designed to prepare it for ISO-9002 registration.

Selected outcomes:

Cheraw implemented the necessary improvements to become the first manufacturer of sales yarn in South Carolina to be ISO-certified. Improved operations company-wide have made an immediate positive impact in a number of areas. Customer complaints are down 15 percent, reducing costs by $10,000. A 25-percent decrease in nonconforming product has produced a savings of $30,000. Cheraw is also considering expanding its product line and, with ISO certification, will attract a larger customer base. Finally, Cheraw has maintained its position as a leader in the sales yarn market, differentiating itself against tough competition.

Summary of Estimated Economic Impact

Labor/material decrease	$10,000	Capital avoidance	$30,000
Total Estimated Economic Impact:	$40,000		

Note: This represents an estimated economic impact as of March 1996. The full implications of Cheraw's ISO-9002 registration have not been realized and will continue to be measured.

MANUFACTURING EXTENSION PARTNERSHIP

SUCCESS STORY

CONN/STEP, New Britain, Conn.

Conservation Alliance, Inc. (CAI), Southbury, Conn.

Manufacturer and seller of exit signs

Number of Employees: 4

Based on the case by Tab Wilkins, CONN/STEP

Project(s):

Technical assistance to lower costs and increase sales. CAI was forced to deal with an increasingly competitive market, including decreasing prices caused by competition and increasing consumer emphasis on quality. CONN/STEP provided 51 hours of assistance to CAI. On CONN/STEP's recommendation, CAI adopted a new manufacturing process based on plastic rather than metal components. Called injection molding, the process extended the life of the sign by incorporating improved electronic circuitry. Two hundred hours of outside consulting expertise helped CAI implement the process. Further efforts are underway to develop a retrofitting kit to permit easy conversion of old signs to CAI's new sign.

Selected Outcomes:

The use of CONN/STEP-recommended plastics and injection molding increased CAI's output five-fold—to 200 signs a day. It also cut the company's manufacturing costs in half, as injection molding required fewer parts and assembly steps while offering improved durability and optical diffusion of the display. Improvements in the electronic circuitry allowed CAI to offer customers a 10-year guarantee for the life of its signs. These process and product changes increased CAI's market competitiveness. The company doubled its sales in 1995, compared with 1994, thereby creating 12–15 new jobs related to manufacturing and assembly operations.

Illustrations of results are available from the author by request.

SUCCESS STORY

Great Lakes Manufacturing Technology Center (GLMTC)
Cleveland, Ohio

Custom Materials (Custom), Cleveland, Ohio

Manufacturer of electrical insulation products used mainly by Fortune 500 companies

Number of employees: 85

Based on the case by Thomas Szabo, GLMTC

Project(s):

Technical Assistance (TA) to effect manufacturing process improvements. GLMTC assisted Custom in bringing about manufacturing process improvements by locating and implementing the appropriate technology and techniques. A total of 33 TA activities for Custom began with a complete operations assessment and related recommendations for change. GLMTC engineers worked with Custom to develop a new plant layout, quality assurance and business information systems, and waste reduction, environmental, and business systems projects.

Selected Outcomes:

GLMTC recommendations implemented by Custom have greatly improved the company's manufacturing performance. Improvements have resulted in reduced scrap rates, increased percentage of on-time delivery, more efficient use of capacity, greater productivity, decreased lead time, reduced inventory, and a quicker response to customer demands. These improvements have allowed the company to increase production, quality, and margin, and reduce costs and waste. Custom feels it has addressed its operational issues and now can better position itself strategically in the industry and in the global marketplace.

Illustrations of results are available from the author by request.

SUCCESS STORY

The West Virginia Partnership for Industrial Modernization (WVPIM)
West Virginia Institute of Technology, Montgomery, W.V.

D.J. Manufacturing, Inc. (DJMI), Huntington, W.Va.

Machine shop manufacturer of discrete parts for underground coal mining industry

Number of employees: 40

Based on the case by Lawrence Dixon, WVPIM

Project(s):

Two technical assistance projects identifying outside resource. As part of DJMI's move to diversify its business offerings, WVPIM assisted DJMI in identifying an outside resource to help develop a drawing of a prototype braking system for a large earthmover. As recommended, DJMI contacted the Robert C. Byrd Institute for Advanced Flexible Manufacturing Systems (RCBI), which used an in-house coordinate measuring machine and a CAD package to successfully produce the drawing. WVPIM also assisted DJMI in resolving problems it was having with a new CAD/CAM computer system. Again, working with RCBI, WVPIM recommended appropriate computer hardware, software, and training to meet DJMI's needs.

Selected Outcomes:

Completion of its computer project, spearheaded by the efforts of WVPIM and RCBI, gave DJMI a real competitive advantage. Using its CAM package to create the programs required to machine the part drawing created in a CAD system, DJMI has significantly reduced the time it takes to put a new part into production—from weeks to mere days. Success with its new shop program enabled DJMI to justify the purchase of a new vertical milling machine, which provided even greater efficiencies in the iterative design process. DJMI also experienced an 18.6 percent reduction in labor costs while sustaining production levels after one year of the CAD/CAM improvements.

Illustrations of results are available from the author by request.

SUCCESS STORY

Massachusetts Manufacturing Partnership (MMP) at the Bay State Skills Corporation, Amherst, Mass.

Extrusion Technology, Inc. (Extrusion), Randolph, Mass.

Manufacturer of extruded aluminum parts and assemblies

Number of employees: 60

Based on the case by Eric Heller, UMASS Donahue Institute, on behalf of the MMP.

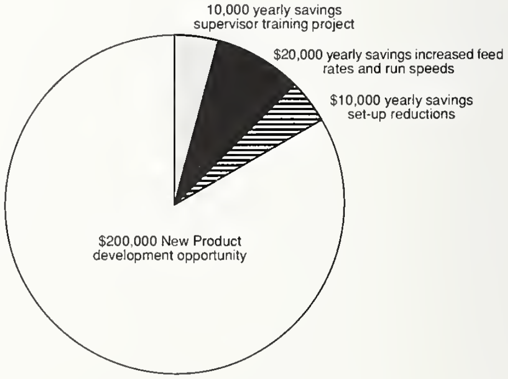
Project(s):

Three Technical Assistance (TA) projects addressing communications, productivity, and marketing issues. MMP offered Extrusion a broad understanding of these issues and access to an extensive network of public and private consulting resources. Specific projects sought to improve cross-department supervisor communication and production scheduling, reduce set-up times in the machining department, measure customer satisfaction, and identify new product development opportunities. The latter two were accomplished through a customer-oriented market survey.

Selected Outcomes:

The TA projects initiated by MMP for Extrusion improved business performance in several areas. More sophisticated production scheduling techniques greatly reduced late shipping rates—from 17 percent to 5 percent. Extrusion's president and owner attributes $10,000 in direct savings to the supervisor training project. As a result of the reduction in set-up time, productivity in the machining department has increased between 100 and 200 percent depending on the component being run at the time of measurement. Bottom-line savings total $10,000 annually in set-up reductions and $20,000 per year attributable to increased productivity from feed rates and run speeds. The momentum created by this modernization project has prompted an additional investment of over $50,000 in new equipment, which will give the company an even greater competitive advantage. Finally, the market research survey presented the company with $200,000 in new product development opportunities, with greater future benefits expected.

Summary of Economic Benefit



MANUFACTURING EXTENSION PARTNERSHIP

SUCCESS STORY

Massachusetts Manufacturing Partnership (MMP) at the Bay State Skills Corporation, Amherst, Mass.

Galileo Corporation (Galileo), Sturbridge, Mass.

Manufacturer and marketer of glass fiber and electro-optic components, assemblies, and systems

Number of employees: 200

Based on the case by Steven Ellis, UMASS Donahue Institute, on behalf of the MMP.

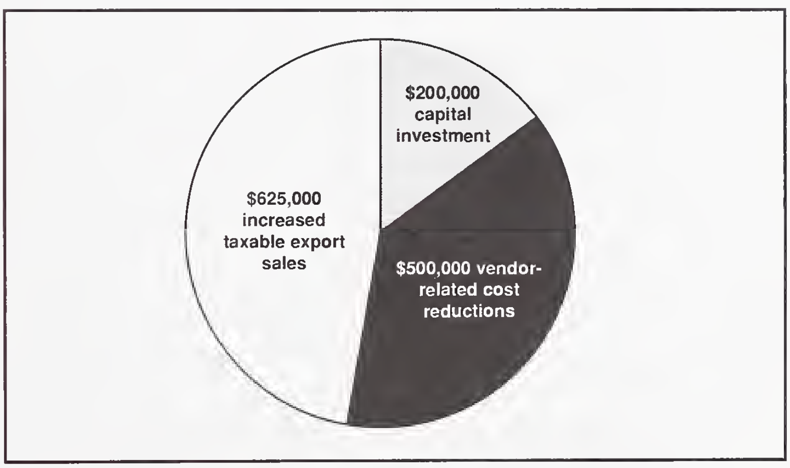
Project(s):

Three Technical Assistance (TA) projects, and identification and management of consultant resources. MMP provided Galileo with three different TA projects designed to improve its competitiveness by (1) enhancing micro-channel plate inspection through automation, (2) improving productivity on a specific product line, and (3) rationalizing Galileo's vendor purchases. MMP also identified and managed consultant resources to meet Galileo's particular needs.

Selected Outcomes:

As a result of MMP projects, Galileo has decreased costs and increased productivity and sales, while competing in a global marketplace. Specifically, these projects have afforded Galileo a direct benefit of $1,125,000 annually through increased taxable export sales of $625,000 and vendor-related cost reductions of $500,000. They also provided an additional $200,000 in business to domestic vendors and created 21 new jobs.

Total Benefits Derived from Improvements



SUCCESS STORY

Chicago Manufacturing Center (CMC)
Chicago, Ill.

Glendale Technologies Corporation (GTC), Lisle, Ill.

Assembles and sells low-cost computer system

Number of employees: 21

Based on the case by Natalie Davila, CMC

Project(s):

Assistance in increasing profitability and customer base. CMC assisted Glendale Technologies in the areas of personnel, market expansion, and quality assurance. It also helped GTC attain minority certification status and certification as a Small Business Administration disadvantaged contractor, thus enabling the firm to negotiate as a sole source supplier for Federal procurements.

Selected outcomes:

Better business practices, achieved through CMC's assistance, have improved GTC's financial position considerably. Increased sales, reduced debt, and lowered scrap and reject rates all have resulted. The company has increased its profit margin significantly and taken advantage of its minority-owned status to obtain new business—worth about half a million dollars. Several more contracts are expected as GTC expands its customer base and moves into the export business. Through CMC's "Finding Your Next Customer" program, GTC has drafted a business plan aimed at achieving $100 million in sales over the next 5 years.

Project-Related Benefits to Glendale Technologies

	1992	1993	1994	1995	1996
Sales (millions)	$4.72	$8.94	$5.90	$5.25	$7.00
Cost of Goods (millions)	$4.31	$8.02	$5.22	$4.70	$5.77
Gross Margin (millions)	$0.41	$0.92	$0.68	$0.55	$1.23
Scrap Rate		3.2 %		2.4 %	
Reject Rate		2.0 %		1.5 %	

SUCCESS STORY

Lake Erie Manufacturing Extension Partnership, a division of the Edison Industrial Systems Center (EISC)
Toledo, OH

Haas-Jordan, Inc., (Haas-Jordan), Toledo, Ohio

Manufacturer of umbrellas and related products

Number of employees: 55

Based on the case by Richard L. Hanson, Lake Erie Manufacturing Extension Partnership

Project(s):

Technical assistance in identifying and implementing improved business practices. EISC assisted Haas-Jordan with several improvement projects. First, it helped the company locate a facility to conduct wind-velocity testing of its umbrellas. Follow-on projects included installation of improved silk-screening operations, development of a fabric canopy adhesive, and integration of benchmarking tools. In addition, project efforts initiated prototype design and production of new umbrella components.

Selected outcomes:

Haas-Jordan has benefited from changed business practices and performance. The new silk-screening machine, by accommodating larger logos, furnished the company a custom logo market niche worth an estimated $250,000 in additional revenues. Also, only one worker now runs the silk screening operation, which is 25 percent more efficient and yields a productivity improvement worth $8,000. Other projected economic benefits include a $10,000 savings related to wind tunnel testing, $6,000 to adhesive development, and $1,200 to prototype development. The total realized annual cost savings is $45,200 or $3.56 for each dollar invested in EISC.

Project-Related Realized Annual Cost Savings

Year	Annual Cost Savings
1995	$10,000 wind-tunnel testing savings
1995	$8,000 productivity improvement in silk screening of large umbrella operation
1995	$20,000 incremental contribution of margin hoop lift frame system for large logos
1996	$6,000 projected economic impact of adhesive interface development
1996	$1,200 projected economic impact for prototype development of new umbrella parts
1996	$45,200 in realized annual cost savings

BOTTOM LINE: $3.56 return for each dollar invested

SUCCESS STORY

Alliance for Manufacturing and Technology (AM&T), formerly University/ Industry Public Partnership for Economic Growth (UnIPEG), Binghamton, N.Y.

Ithaca Peripherals, Inc. (IP), Ithaca, N.Y.

Manufacturer of point-of-sale (POS) printers for printing receipts and tickets

Number of employees: 85

Based on the case by Douglas Welch, Nexus Associates, on behalf of the AM&T.

Project(s):

Technical assistance in the form of direct services and consultant management. AM&T helped identify and subsequently manage a consultant hired to implement a new manufacturing operations management information system (MIS) and related changes in the production process. These changes included the addition of "fourth shift" information system software and a new floor organization. Other AM&T services included development of a manufacturing strategy plan. This plan assessed the business environment at IP and identified tools to help the company improve product quality and manufacturing operations. The company also adopted a system to measure customer satisfaction.

Selected Outcomes:

Technical assistance helped transition the company from a "mom and pop" shop, where no one was operating on the same information, to a company with integrated operations. Major project components in the manufacturing plan resulted in better performance and reduced unit costs and/or increased unit revenues. New quality control procedures cut the number of warranty returns—from 50 percent for "Model A" in 1993 to 5 percent in 1995. Estimated savings from an increased first-pass yield rate—from 92 percent in 1994 to 96 percent in 1995—equaled approximately $12,000. Estimated total savings from these projects is expected to be around $30,000 the first year.

Warranty Return Rate

	1993	1994	1995
Model A	50 %	40 %	5 %
Model B	2.75 %	2.65 %	1.50 %

Source: IP Data

SUCCESS STORY

Industrial Technology Assistance Corporation (ITAC)
New York, N.Y.

KD dids, Inc., (KDdids), New York, N.Y.

Manufacturer of dancewear

Number of employees: 40

Based on the case by Claire Brownstein, ITAC

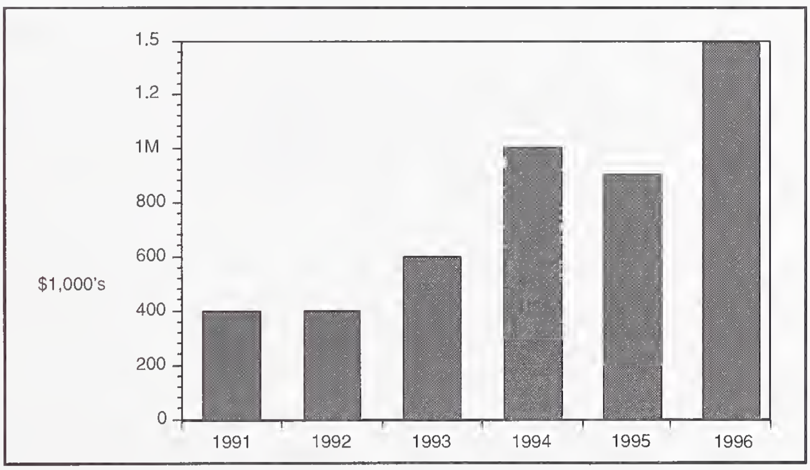
Project(s):

Assessment and technical and business assistance to help grow a small company's business. Working with a local economic development corporation in 1992, ITAC helped the company secure a $100,000 loan to purchase new equipment to meet increasing demand. In 1994, ITAC then recommended a comprehensive productivity improvement project to help KD dids accommodate its growth, assess its requirements, and formalize and modernize its operations. In addition, ITAC assisted the company in obtaining a grant from the New York State Industrial Effectiveness Program (IEP) to offset partially the cost of the productivity project.

Selected Outcomes:

The intial bank loan doubled KD dids' production capacity enabling the company to meet the market demand for its popular products. Once KD dids had a credit history, it was able to finance privately six more machines. The productivity improvement project resulted in expanded and cost-effective operations. Order turn-around time decreased from 14 weeks in 1993 to 3-4 weeks today and shop layout changes incorporated a new cut-and-sew operation. KD dids doubled its sales, from $400,000 in 1991 to nearly $900,000 in 1995, and projects 1996 sales of $1.5 million. With increased sales, the company hired 26 aditional employees from its South Bronx neighborhood and generated additional tax revenues.

KD dids Annual Sales



Center for Economic Growth (CEG)
Albany, N.Y.

Kintz Plastics, Inc. (Kintz), Howes Cave, N.Y.

Thermoforming manufacturer of large plastic components

Number of employees: 135

Based on the case by Douglas Welch, Nexus Associates and the CEG

Project(s):

Assistance in installing a new information system to improve company operations. Through CEG, Kintz received a floor plan for forming a workshop extension, along with reduced-fee ISO-9000 certification—the first such thermo manufacturer to receive ISO certification in the U.S. The company also received assistance in developing new automotive products being marketed in Japan, and in adding a job-tracking capability for purchasing, inventory control, and job ticketing and routing.

Selected Outcomes:

The new computer systems helped Kintz to substantially increase its productivity and output, with sales rising to $7.5 million in 1995, from $2 million in 1990. A system-related increase in capacity helped "grow" the company from 95 employees in 1992 to 110 in 1994. For the same period, manufacturing lead time was reduced from 70 to 56 days. Product scrap rate was reduced from 6 percent to 4.2 percent, and customer rejects from 2.3 percent to 1.2 percent. The new layout plan improved workflow and overall plant efficiency, obviating the need to relocate work in progress. Finally, Kintz was able to bid on and win a contract for two new products through CEG-obtained access to digitizing equipment. The contract resulted in $50,000–$100,000 in export sales for Kintz. Overall, Kintz estimates that its investments of approximately $100,000 in MEP-affiliated improvements have produced $2 million in benefits to the company.

Impacts of Production Improvements

	Before 1992	After 1994
Number of employees	95	135
Manufacturing time	70 days	56 days
Product scrap rate	6 %	4.2 %
Customer rejects	2.3 %	1.2 %

MANUFACTURING EXTENSION PARTNERSHIP

SUCCESS STORY

Long Island Forum for Technology (LIFT)
Long Island, N.Y.

Luitpold Pharmaceuticals, Inc. (Luitpold), Shirley, N.Y.

Manufacturer and packer of generic injectable drugs

Number of employees: 300

Based on the case by Douglas Welch, Nexus Associates, on behalf of LIFT

Project(s):
Assistance in improving Luitpold's efficiencies in the production line. The primary assistance LIFT managed was a grant from the New York State Industrial Effectiveness Program (IEP), a mentoring program that provides financial asssistance to firms for modernization efforts. Services included help in calculating costs and in selecting consultants. Rather than make dramatic changes to the manufacturing process, the consultants reorganized product line information into a more manageable form. They provided tools to help the company monitor the work flow and to associate processes with costs. Workplace changes included new material flow and production tracking systems, improved production line efficiency, and provision of production data to those responsible for controlling the process.

Selected Outcomes:
Luitpold's new system resulted in a reduced unit cost of production, reduced labor cost through overtime reduction, and reduced scrap rate.

Benefits Derived from Project-Related Investment

SUCCESS STORY

Northwest Wisconsin Manufacturing Outreach Center, (NWMOC)
Menomonie, Wisc.

Marplex, Inc. (Marplex), Rhinelander, Wis.

Manufacturer of wood crating and wood pallets

Number of employees: 125

Based on the case by Orville Nelson, NWMOC

Project(s):

Technical assistance projects to improve plant layout, materials handling, and production systems. NWMOC provided several technical assistance projects to Marplex. It helped the company redesign the infeed system for the plant's sawmill, reorganize production processes into a cellular layout, and develop a preliminary storm-water pollution plan. Marplex employees also participated in an NWMOC value-added manufacturing seminar and learned systematic problem-solving techniques.

Selected outcomes:

NWMOC projects reduced work in process and materials handling activities, while increasing output per person hour. Marplex plant managers also learned to view manufacturing systems with an eye to value added process. The NWMOC project generated $120,000 in annual savings for the company. The cellular layout project in Plant 1 improved production processes to the tune of $7,000 per month—savings generated by less down time, overtime work, and work in process. The new infeed system for Plant 3 eliminated the need for a full-time person, reduced down time for the sawmill system by 80 percent, and reduced maintenance time by 12 hours—a savings of at least $3,000 a month. The storm-water plan has resulted in a more effective dust collection system and less wood and petroleum waste on plant grounds. Finally, increased capabilities developed at Marplex will help preserve 125 jobs at the company.

NWMOC-Generated Improvements to Marplex

• Increased output per person hour. • Reduced downtime for sawmill—by 80 percent. • Reduced work in process and material handling. • $120,000 annual savings.	• Improved production processes worth $7,000/month. • Eye to value-added processes. • Preservation of 125 jobs. • Reduced maintenance requirement worth $3,000/month.

SUCCESS STORY

Georgia Institute of Technology, Georgia Manufacturing Extension Alliance (GMEA)
Atlanta, Ga.

RCF Seals & Couplings, Inc. (RCF), Vidalia, Ga.

Manufacturer of seals and couplings for the aerospace industry

Number of employees: 32

Based on the case by Jan Youtie, Economic Development Institute, Georgia Institute of Technology, on behalf of GMEA

Project(s):

Technical assistance in arranging required product performance testing. GMEA provided 20 hours of assistance arranging for the timely testing of RCF's new seal, which it was trying to sell to Learjet, Inc. Through the Direct Assistance Programs at the Oak Ridge National Laboratory, GMEA located and arranged for 160 hours of technical assistance for RCF at Oak Ridge's High Temperature Materials Laboratory, which performed the requisite high-temperature portion of the testing. Simultaneously, the GMEA office manager contacted the Warner Robins Air Logistics Center to perform the cold-temperature test.

Selected outcomes:

RCF's seal was the first of its kind to successfully pass both the high- and cold-temperature tests. As a result, RCF closed a deal worth $2 million and discovered the benefits of working directly with Federal labs on non-proprietary research at no cost. Now, the company is planning other industry applications for the seal and has added 10 new employees to create a new "middle management" layer. RCF credits its product with the potential to generate another $50 million in sales, and believes export sales of the seal could eventually equal domestic sales. RCF is exploring the possibility of licensing the testing apparatus from Oak Ridge, which would give the company in-house testing capability.

Results of GMEA Assistance

Before GMEA Assistance	After GMEA Assistance
• No proof of high-temperature tolerance	• Testing shows seals can withstand required temperature ranges
• No in-house testing capabilities	• Established ongoing relationship with Federal laboratory
• $1.2 million in sales	• Additional $2 million booked over 2 years
• 95 percent of sales to domestic aerospace customers	• Potential for more export sales and sales in petrochemical industry
• 22 employees (top managers performed supervisory functions)	• 10 new jobs, with "middle management" layer added

SUCCESS STORY

Southeast Manufacturing Technical Center (SMTC)
Columbia, S.C.

Shakespeare Electronics and Fiberglass (Shakespeare), Newberry, S.C.

Manufacturer of fish and tackle products

Number of employees: 355

Based on the case by English Drews, SMTC

Project(s):

Technical assistance (TA) in carrying out a new product development project using new approaches and technologies. Shakespeare wanted to extend the product life cycle of its current *Ugly Stick*[R] by developing a new-generation fishing rod. SMTC at the University of South Carolina (USC) introduced the application of a computer-simulation tool to predict the sensitivity, weight, and functionality of the new design. In a second phase, SMTC designed and built prototype rods to verify the computer simulation. It later developed alternative processes for optimizing product designs for several other rod types, with the goal of introducing the products at the July 1995 American Sportfishing Association (ASA) show.

Selected outcomes:

Shakespeare's new *Ugly Stick*[R] *Lite Series* was enthusiastically received at the ASA conference and by consumers. Within 5 months after it was introduced, the rod achieved 90 percent of forecasted annual sales. With an estimated product life of 10 years, the new rod has total projected sales of $7,700,000. It is also stronger, weighs less, and uses less product material than the old version. In addition, use of computer-simulation tools significantly reduced time-to-market and new product development expense. Finally, a successful new product introduction has had a direct impact on the job security of 20 percent of Shakespeare's work force, and has helped to solidify the company's reputation and market position.

Summary of Estimated Economic Impact

Capital Investment	$150,000
Sales Increased *(over the life of the product)*	$7,700,000

MANUFACTURING EXTENSION PARTNERSHIP

SUCCESS STORY

Lake Erie Manufacturing Extension Partnership, a division of the Edison Industrial Systems Center (EISC)
Toledo, Ohio

Sherwood Plastics, Inc., (Sherwood), Fostoria, Ohio

Rotational plastics molder

Number of employees: 86

Based on the case by Richard L. Hanson, Lake Erie Manufacturing Extension Partnership

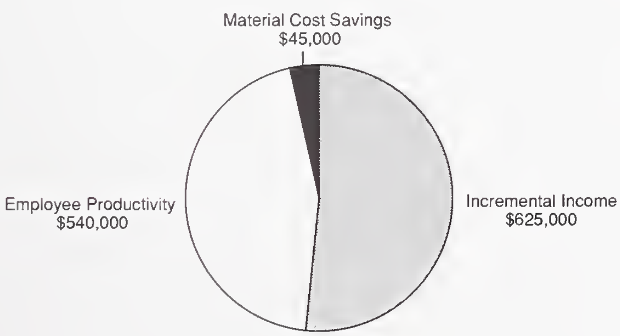
Project(s):

Assistance in growing a small business through value-added operations and product-line diversity. EISC assisted Sherwood with an expansion plan, which doubled its facility while providing space for additional molding equipment. The plan also consolidated off-site storage and incorporated just-in-time manufacturing concepts. A new manufacturing layout completely rearranged the factory to incorporate more cost-effective and efficient processes. Other projects that complemented Sherwood's growth involved use of benchmarking tools, development of information systems, and suggestions for waste reduction.

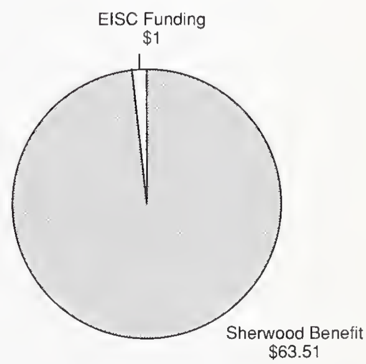
Selected outcomes:

Construction of a new facility for Sherwood has effected many of EISC's recommended business practices. As a result of these changes, Sherwood is saving over $45,000 a year in raw material cost alone. Material handling costs have also been reduced, and quality has improved. Consolidating all operations in the new facility has mitigated the cost of offsite warehouses and additional material handling. The use of workcell concepts has greatly improved work force productivity. Sales per employee have risen from approximately $50,000 to $70,000, giving the company an annual cost benefit of $540,000 in employee productivity. Sales have increased from $3.5 million in 1993 to $6 million in 1995, producing $625,000 in incremental income. The total realized annual benefit is approximately $1.2 million.

Annual Cost Benefits from EISC-Assisted Projects



Ratio of Sherwood Benefit to EISC Funding



SUCCESS STORY

North Carolina Manufacturing Extension Project (NCMEP), Center for Economics Research, Triangle Park, N.C.

Timberlyne Cabinet Company (Timberlyne), Angier, N.C.

Manufacturer of frameless wooden cabinets

Number of employees: 32

Based on the case by Sheila Martin, Research Technology Institute, on behalf of NCMEP

Project(s):

Technical assistance (TA) in four areas of company operations. NCMEP assisted Timberlyne with four different technical performance issues, researching problems and consulting outside experts for proposed solutions. Specifically, NCMEP recommended solutions to Timberlyne's problems with inconsistent finish quality on products processed in the spray paint booth and inferior performance of ultraviolet curable coatings. Unacceptable properties and cost of medium-density fiberboard supplies were also addressed, along with environmental permitting issues related to airbag return air. Timberlyne initiated a number of activities to correct these problems and earn the company positive results.

Selected Outcomes:

NCMEP's recommendations regarding the spray paint booth allowed Timberlyne to paint without swirling, dust, and backspray, which doubled throughput—from 30 doors per hour to approximately 62.5 per hour. This production increase saved the company $1,157 per 1000 doors in labor costs and reduced materials costs as well. A new ultraviolet curing process, made possible by MEP-recommended suppliers, resulted in an annual materials savings of $177,200, labor savings of $56,000, and belt savings of $22,000. Additionally, the company reduced its customer reject rates and increased on-time delivery. A recommendation that Timberlyne continue to work with Georgia Pacific to discover a supplier for properly performing medium-density fiberboard saved the company $101,120. Finally, a recommendation to apply for a special federally enforceable, flexible air permit effected a savings of $4,750. In total, annual savings were $443,120 for all outcomes. Timberlyne also eliminated 228,500 pounds of VOC emissions per year.

SUCCESS STORY

CONN/STEP, New Britain, Conn.

Trident, Inc., (Trident), Brookfield, Conn.

Manufacturer of ink and ink jet printer head systems

Number of employees: 110

Based on the case by Tab Wilkins, CONN/STEP

Project(s):

Technical assistance (TA) in locating outside consultants to improve production and accommodate growth. CONN/STEP helped Trident with two improvements central to its successful product development and continued growth: plant layout to accommodate expanded ink production and the introduction of work cells to improve workflow on the printer head line. Trident and its employees received TA in locating the external expertise required to develop the new layout and to set up and operate the new work cells. CONN/STEP is also working with the company on another project to automate parts of the ink production line.

Selected Outcomes:

Changes made by Trident resulted in a new workflow, improved throughput, and reduced inventory. The improved ink production layout allowed Trident to reduce its work in progress from $1.6 million to $800,000 within 2 months. Also, the cycle time for the ink jet head printer calibration decreased to one day from four weeks, eliminating the need for high levels of related inventory. Greater productivity and reduced costs will let the company continue to be a strong force in the marketplace.

Project-Related Production Improvements and Impacts

- Increased production 25–35% without increasing direct labor cost.
- Reduced ink production work in progress from $1.6 million to $800,000 in two months.
- Doubled throughput of ink jet printer head line and increased responsiveness to quality issues.

MANUFACTURING EXTENSION PARTNERSHIP

SUCCESS STORY

The West Virginia Partnership for Industrial Modernization (WVPIM) Montgomery, W.V.

Walker Systems, Inc. (WSI), Parkersburg, W.Va.

Manufacturer of electrical and communications distribution systems

Number of employees: 300

Based on the case by Lawrence Dixon, WVPIM

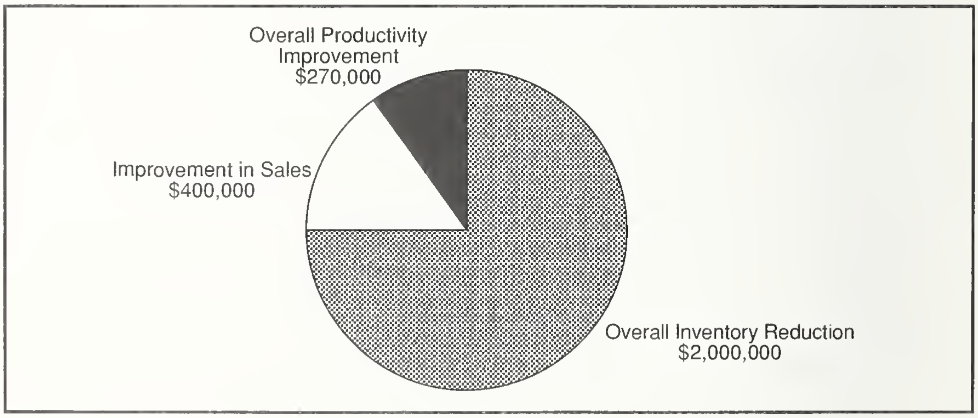
Project(s):

Assistance in evaluating plant's quality management system and manufacturing capability. WVPIM performed quality and production process assessments for WSI, which revealed inefficiencies in the company's use of a traditional batch-type manufacturing process. To remedy this problem, WSI undertook a comprehensive "flow-thru" manufacturing project, implementing several recommendations for process changes. These included incorporating just-in-time philosophies and focused factory techniques, implementing a pull-production system to reduce inventories, increasing the number of work cells, and installing a real-time computerized job tracking and scheduling system.

Selected outcomes:

Following completion of its "flow-thru" manufacturing project, WSI realized significant monetary benefits from shortened production lead times, improved labor use, and reduced manual handling, inventory costs, and floor space requirements. WVPIM assistance netted $2,670,000 worth of financial benefits to WSI. Operational improvement by category shows $2,000,000 in overall inventory reduction, $400,000 in sales, and $270,000 in overall productivity. The company also has factored faster cycle times and improved work flow into the floor space design of a new facility.

WVPIM-Related Monetary Impacts



CASE STUDIES

Case Study

BARON INDUSTRIES CORPORATION

Dalton, Georgia

GEORGIA MANUFACTURING EXTENSION ALLIANCE

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Jan Youtie

Economic Development Institute

Georgia Institute of Technology

Atlanta, Ga.

CASE STUDY

Baron Industries Corporation

Baron Industries Corporation (Baron) assembles glass tops for premium ovens. The family-run business is headquartered in Dalton, Georgia, which is 90 miles north of Atlanta. Baron employs approximately 150 workers roughly divided among its three facilities in Dalton; Findlay, Ohio; and Louisville, Kentucky.

GMEA Provides New Plant Layout

Baron's 22,000-square-foot leased facility was too small for the volume of work it had and for its material and inventory storage needs. The company purchased a 47,000-square-foot building a few miles north of its leased Dalton facility in the summer of 1995. This purchase provided 31,000 square feet of operating space for Baron, as it leased part of the facility to another company.

After attending one of GMEA's ISO-9000 documentation courses and learning about GMEA's other service offerings, Baron's then plant manager contacted GMEA's Dalton regional office manager to obtain assistance with the design for the new building. GMEA staff, which included a Georgia Tech co-op student, reviewed Baron's paper-based plans and process analysis and took measurements at the old and new facilities. Within a week, GMEA staff provided Baron with three alternative computer-generated layouts. Baron's CEO and plant manager worked closely with the co-op student over the next 2 months to modify the layout based on the requirements of potential future customer assembly contracts.

GMEA staff also offered several process improvement recommendations. These improvements mostly involved the cleaning and waste removal functions. Among the recommendations was to purchase a screw-type air compressor rather than the cylinder-type currently used.

Baron was simultaneously considering upgrading its manufacturing to include software for barcode technology and business planning and control functions, but management was not sure whether such software was appropriate for its small firm. The GMEA regional office manager forwarded the request to GMEA's Center for Manufacturing Information Technology (CMIT), a GMEA center jointly sponsored by Georgia Power Company and Georgia Tech. CMIT demonstrated several software systems to Baron's general manager. Although Baron ultimately decided to use a product not demonstrated at CMIT, the CMIT demonstration showed management "the value of the systems."[1]

GMEA provided approximately 90 hours of layout-related assistance (mostly student time), and another 15 hours for the software demonstration. Baron staff committed approximately 90 days to the project. Table 1 summarizes the assistance provided by GMEA.

Table 1

Summary of Assistance and Impact

COMPANY INFORMATION	• Baron Industry Corporation assembles glass range tops; 50 employees at headquarters facility in Dalton, Georgia
NEED	• Plant layout for new facility; ISO-9000 documentation, auditor instruction
GMEA RECOMMENDATION	• Developed plant layout; recommended software, equipment, operational changes; provided documentation instruction
INTERMEDIATE IMPACTS	• Acquisition of quality management skills • 40% increase in direct labor productivity • $150,000 capital investment in the facility • $86,000 business management software system investment
FINANCIAL BENEFITS AND JOB IMPACTS	• $8 million new sales (plant layout used as sales tool) • $100,000 operating savings • $750,000 inventory savings • 16 new jobs

Baron Moves, Improves Productivity

Baron moved into its new facility in October. Its then plant manager reported that, "[The GMEA] service allowed Baron Industries Corporation to move into a new facility 2 months sooner than anticipated." Careful planning allowed for a complex move to be completed in two days with minimum effect on production output, he continued. "We operated at 95 percent efficiency the first day after the move."[2]

Process improvements incorporated into the layout prompted a 40-percent increase in direct labor productivity for Baron's three highest-volume product lines. Direct labor costs decreased from nearly $12 per unit before the move to $7 per unit after the move for these product lines.[3]

The layout also stimulated significant inventory savings. Because the new design allotted less space for inventory, Baron management had to sort through its inventory to determine which items to keep and which to return to suppliers. A substantial portion of slow-moving inventory was sent back to suppliers, resulting in a one-time savings of $750,000 related to inventory, carrying costs, and applied interest. Baron has since hired a corporate director of materials to help with inventory control.

In an interview, the then plant manager referred to a prevailing mindset that the company needed only six workstations, when, in fact, workers had been putting in significant amounts of overtime at the old facility, partly because of this capacity limitation.[4] GMEA's plant layout allowed for two additional workstations. Baron added one new workstation upon moving into the new facility, saving itself $44,000 in overtime pay the first month. Baron expects to save about $100,000 in overtime pay over the course of a year.

Baron's capital investment in the new facility totaled over $100,000. This investment includes a new air compressor for $2,000 less than the one Baron had been considering. Further, the company anticipates a one-third reduction in energy costs to operate the new compressor compared to the one they were considering. The company also decided to make an $86,000 investment in business planning and control software.

Attending GMEA's ISO-9000 documentation course gave the Baron manager new skills for reviewing his company's procedures and work instructions, and helped him to configure work processes more logically. The inspection function was moved to the beginning of the process, to allow inspection of all incoming glass. As a result, Baron's internal scrap rate was reduced from 80 percent to 10 percent, which yielded nearly $5,000 in savings over a three-week period. Realizing the great benefits of GMEA's instruction, Baron has contracted with an ISO-9000 registrar. Table 2 summarizes these benefits.

Plant Layout Helps Close Sale, Create New Jobs

Baron asked GMEA staff to produce several copies of the computer-generated plant layout. These

copies were incorporated into sales presentations to GE/Roper, one of Baron's biggest customers. GE/Roper was concerned about having a separate space in the plant for a major subassembly. Baron used the computer-generated layout to show where the space was available—information that helped Baron close an $8 million sale.[5]

The plant layout justified the addition of 16 new jobs including both hourly and management positions.

Ten new hourly workers were hired to operate the new workstation. Additionally, sales growth has permitted Baron to add a middle management layer; therefore, six salaried positions have been or will be added this year, including a quality manager, a materials manager, two accounting staff members, a materials control supervisor, and an office manager/human resource specialist. Table 3 summarizes these sales and job impacts.

Table 2

Benefits In Manufacturing Performance From GMEA Assistance

BARON NEED	GMEA RECOMMENDATION	BARON ACTION	IMPACT
New plant layout	Provided computer-generated layout	Implemented new plant layout, reduced inventory	• $150,000 capital investment in facility • $750,000 one-time • inventory savings • 40% increase in direct labor productivity
Capacity limitation with 6 workstations	Add 2 more workstations	Added 1 workstation (other stations in planning)	• $44,000 savings in November from eliminating overtime pay • $2,000 capital expenditure for workstation
Purchase of new air compressor	Screw-type compressor	Purchased compressor	• $2,000 savings over what would have been purchased • Anticipate one-third reduction in energy costs (approx. $2,200)
High scrap rate	Documentation of procedures, work instructions, policies	Moved inspection point to beginning of process	• $4,800 savings from non-conforming glass over 3-week period
Inventory and accounting control	Barcoding and business management systems	Purchased software	• $86,000 investment Anticipate return on investment within 1 year

Table 3

Sales and Job Impacts From GMEA Assistance

GMEA RECOMMENDATION	BARON ACTION	SALES/JOB IMPACTS
• New plant layout with separate • Used computer-generated	subassembly area layout to close sale	• Implemented plant layout • $8 million sale contracted • 6 new salaried jobs
Add 2 more workstations	Added 1 new workstation	10 new hourly jobs

Role of GMEA and Market Conditions

Although Baron had already developed a plan for laying out the new facility, assistance from GMEA played a significant role in the final design. Management valued the give-and-take with GMEA staff during the months prior to the move, as well as the industrial engineering expertise, which, according to Baron's president, "you can't get from an architectural firm."[6] Baron's CEO said, "I didn't believe we could get it all in there. But they laid it out, they were right."[7]

Baron's sales increase also benefitted from favorable external market conditions as the market share of glass-top ovens in the United States rose from 3 percent to 20 percent over the past five years.[8] Furthermore, pressures to maintain cost competitiveness in a high-volume, price-sensitive, mature industry (see Table 4) have encouraged outsourcing of assembly functions. Nevertheless, competitive practices of other firms operating in Baron's niche make the company's manufacturing processes important to acquiring new business. When asked about his own role in the outcomes, one Baron manager said that he would "attribute most of the impacts to GMEA's assistance."[9]

Table 4

Household Cooking Equipment Industry Value Of Shipments: 1987 vs. 1994 (Values In Millions Of Dollars)

VALUE OF SHIPMENTS	1987	1994
Current dollars	3,396	3,339
Constant (1987) dollars	3,396	3,270

Source: U.S. Department of Commerce, Bureau of the Census *U.S. Industrial Outlook*, 1994, pp. 36-9.

CHRONOLOGY OF SERVICES

March/April 1995	• Baron attended ISO-9000 course on documentation.
April/May 1995	• Baron negotiated for new document.
June/July 1995	• Baron closed on new building.
July 6, 1995	• Initial meeting between GMEA and Baron. GMEA returned to existing leased facility to gather information for plant layout.
July 7, 1995	• GMEA staff visited new building and took measurements.
July 17, 1995	• GMEA provided Baron with three alternative preliminary CAD drawings; Baron made some changes.
July 1995	• GMEA's energy specialists made recommendations about air compressor suppliers.
July 31, 1995	• GMEA field engineer met with Baron to provide assistance in finding accounting, quoting, and shop floor software.
August 3, 1995	• GMEA field engineer talked to GMEA Center for Manufacturing Information Technology (CMIT) and called vendors to get information about software.
August 1995	• Further changes were made to the layout.
August 16-17, 1995	• CMIT engineer set up demonstration of barcode technology and business management software for Baron. Field engineer scheduled visit with Baron.
August 24, 1995	• Baron Industries Corporation attended CMIT demonstration of manufacturing software.
First week in September 1995	• GMEA co-op student met with president at new facility. They conducted a physical marking of facility for the final layout.
First half of September 1995	• Final layout (excluding office space) completed.
September 13, 1995	• Baron attended ISO-9000 user group meeting coordinated by the GMEA Regional Office at Dalton College.
October 20-21, 1995	• Baron moved into new facility.
November 1995	• Reduced overtime yielded savings of $44,000.
November/ December 1995	• Baron made sales presentation for new subassembly to GE/Roper.
January 1996	• Baron installed business management software; moved glass inspection point to front of process; conducted direct labor productivity study.
End of January 1996	• GMEA provided final plant layout.

ENDNOTES

1. Interview with Baron Industries quality manager, January 22, 1996.
2. "Customer Evaluation of Services," mail questionnaire received from Baron Industries, November 10, 1995.
3. Interview with Baron Industries CEO, January 18, 1996.
3. Interview with Baron Industries CEO, January 18, 1996.
3. Interview with Baron Industries CEO, January 18, 1996.
6. Interview with Baron Industries president, January 18, 1996.
7. Interview with Baron Industries CEO, January 18, 1996.
3. Interview with Baron Industries CEO, January 18, 1996.
9. Interview with Baron Industries president, January 22, 1996.

Case Study

BRAUNSTEIN, INC.

New York, New York

INDUSTRIAL TECHNOLOGY ASSISTANCE CORPORATION

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Claire Brownstein

Industrial Technology Assistance Corporation

New York, N.Y.

CASE STUDY

Braunstein, Inc.

Braunstein, Inc. was established in 1947 as a manufacturer of fine gold jewelry. The firm is co-owned by Jack Granofsky, President, and Joel L. Catania, Treasurer. In 1992, the company employed 80 workers for both importing and manufacturing operations. Today, the company employs 110 workers. The increase is due primarily to the expansion of manufacturing operations.

In 1992, Braunstein occupied one floor—approximately 10,000 square feet—of a mid-town Manhattan building in New York City. In 1995, the firm doubled its operating space by taking over another floor in the building. Four years ago, 65 percent of business was from importing and 35 percent from manufacturing. Today, Braunstein manufacture 50 percent of the fine gold jewelry it sells. Its products are sold to major department stores throughout the country.

The jewelry industry is highly competitive and price sensitive. The price of gold is determined by the international commodity exchange, and selling prices are dictated by market competition. Therefore, profit margins are determined by labor and operational costs. In effect, this means the only real variables for a New York City jewelry manufacturer are productivity, quality, and style.

By the early 1990's, the U.S. jewelry market was being flooded by less expensive imports. According to Mr. Granofsky, Braunstein often could buy goods for less than it cost to manufacture them. It was then that the management team at Braunstein realized that urgent action was needed to keep its factory ope for business.

A particularly persuasive advocate for change wa Salik Khan, a dedicated, long-term employee and the Vice President of Manufacturing. It was Mr. Khan who convinced the rest of the management team that investing in company-wide changes would enable the firm to regain its competitive advantage. At the same time, he also recognized the importance of eliciting buy-in from the workers on the factory floor. He proved to the firm's employees that, ultimately, the changes being considered would benefit them. It was the open and mutually respectful working relationship within the company that created an environment conducive to change.

Once Braunstein recognized the need to change, it turned to ITAC for guidance and technical expertise.

Technical Assistance

Braunstein had learned of ITAC's assistance to New York City manufacturers from a friendly contractor and decided to seek help. After making an initial site visit, a field engineer from ITAC recommended that Braunstein undergo a productivity assessment of its entire manufacturing operations and focus on improving productivity and efficiency. ITAC also worked with Braunstein

to facilitate its participation in the New York State Industrial Effectiveness Program (IEP), which partially funded the productivity initiative. This program is supported by the New York State Department of Economic Development (now called Empire State Development).

At ITAC's recommendation, the company retained an independent jewelry consultant, H.I.A. & Associates. The consulting firm conducted a comprehensive productivity assessment and devised a workable plan for remedial action.

Furthermore, in 1995, it became clear to Braunstein that some of the new hires needed to quickly improve, diversify, and upgrade their skills. The employees needed to be cross-trained to meet more flexible workflow demands and to avoid possible seasonal layoffs. Braunstein once again turned to ITAC to set up an affordable skills training program. The ITAC Project Specialist in Human Resource Training developed and managed a 50-hour skills training project for 15 Braunstein employees. An outside, part-time trainer from the Fashion Institute of Technology in New York City was brought in to conduct the training sessions. Areas of training included jewelry, polishing, and soldering skills.

Changes in Practice

The productivity initiative began in 1993 and focused on improving worker efficiency and reducing costs. These were Braunstein's most crucial problems according to the assessments conducted by ITAC and H.I.A. & Associates. The management team of Braunstein agreed, and productivity improvements began. The following changes in practice occurred:

- *The standardization of all operational procedures.* Prior to the productivity improvements, standards for each manufacturing process were not specified. Standards were created for each operation, and all workers were required to follow the new procedures.

- *The establishment of an improved employee reporting and remediation system.* Before the improvements, the company did not have a way to monitor employees and assist them in improving when necessary.

- *The implementation of a statistical process quality control system (SPQC).* Consistent quality had been a problem for Braunstein. Changes were specifically designed to address all quality issues.

- *The creation of a performance-based incentive program.* This program encouraged greater worker efficiency and improved product quality.

- *The hiring of an in-house, bilingual industrial engineer.* The work force in New York City is culturally diverse. A bilingual, in-house engineer was brought in to ensure clear and continuous communication.

- *The installation of a management training program.* A management training program was conducted to assist in the integration of new procedures and to increase the knowledge base of supervisors and managers.

- *The creation of an affordable skills training program.*

Outcomes

Manufacturing Performance Improvement. The productivity initiative was extremely effective and was marked by significant manufacturing performance improvements within one year of completion. Productivity per employee tripled after the improvements were implemented. Cycle time decreased from 5 weeks to 4 weeks. Reject rates decreased from 10 percent to 6 percent. Overall quality improved an estimated 15—20 percent. The company also is reporting a 15—20 percent productivity improvement for participants in the 1995—1996 training program primarily involving newly hired employees.

Further, Braunstein's capacity utilization has improved. For example, Braunstein was only stamping 60 percent of the products produced in house before the initiative. Since the project's completion, 100 percent of stamping is done within the firm. Even more notable is the change in the company ratio of imported to manufactured products. In 1992, Braunstein imported 65 percent of its products and manufactured only 35 percent. Today, the firm manufacture 50 percent of the products it sells. These improvements are directly attributable to the productivity initiative coordinated by ITAC and implemented through H.I.A. & Associates.

Benefits to the Firm

In 1992, Braunstein was seriously considering closing its manufacturing operations in response to what seemed to be overwhelming overseas competitive pressure. In 1996, closing down its plant is not even a remote possibility. During the early 1990's, the firm's sales had continued to rise—from increased import business—despite waning manufactured product sales. However, after 1994, most of the sales increases were attributed to the company's manufactured goods. Over a two-year period, Braunstein's overseas purchases decreased by over 20 percent.

Increased efficiency has reduced operational costs by 25—75 percent, depending on the specific function. Braunstein's customer base increased due to improved product quality and delivery time, helping the company gain back some of the ground it had lost in the price-sensitive jewelry market. Furthermore, as the company began to shift from importing to more manufacturing, Braunstein became more flexible in terms of product design and delivery. While product lines were expanding, quality was also improving as a result of the statistical control system. A direct relationship existed between the increased value-added built into its products and Braunstein's competitive gains in the marketplace. The final result is the company now produces higher-quality jewelry with greater efficiency at less cost. While the company chose not to reveal the level of profit increase, it has noted that the increase in manufactured products, coupled with the dramatic decreases in manufacturing costs, have significantly increased the firm's overall profitability.

From a broader perspective, according to partners Mr. Granofsky and Mr. Catania, "ITAC played an important role in helping us step up to the challenges that exist in our changing industry." Mr. Granofsky added: "ITAC has a track record of results... It offers a bounty of services to manufacturers who are willing to take advantage of its know-how and resources." Said Mr. Khan: "ITAC is right there helping people who want to improve theirbusinesses. It is great to know that we can tap into their technical expertise as we need to."

Public Benefits

In 1992, before the productivity initiative, 80 employees worked at Braunstein. Today, there are 110. While some of the new hires do not work in manufacturing operations, the vast majority do. Approximately 20 to 25 new plant workers were hired and close to 50 manufacturing jobs were retained as a direct result of the firm's improved and expanded manufacturing operations.

CHRONOLOGY OF SERVICES

1947	• Braunstein is founded. • Braunstein begins to lose competitive ground to imported jewelry.
1992	• ITAC assesses Braunstein's manufacturing operation and recommends a comprehensive productivity improvement project. ITAC identifies industry specialist, scopes work, and helps company obtain an IEP grant.
1993	• Braunstein begins productivity initiative to improve worker efficiency, and product quality, reduce costs, and formalize processes.
1994	• Braunstein's manufacturing performance improves: employee productivity triples, cycle time decreases from 5 to 4 weeks, quality improves 15—20 percent, and costs dramatically decrease.
1995	• Braunstein is now manufacturing 50 percent of its jewelry.
1995 - 1996	• ITAC develops and manages 50-hour skills training project for 15 Braunstein new hires to improve, diversify, and upgrade their skills.
1996	• ITAC continues to provide guidance and access to technical expertise and modernization resources to Braunstein. Braunstein continues to invest in its productivity improvements and its workforce.

Case Study

BUERK TOOL AND MACHINE CO., INC.

Buffalo, New York

WESTERN NEW YORK TECHNOLOGY DEVELOPMENT CENTER, INC.

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Buerk Tool and Machine Co., Inc.

Founded in 1919, Buerk Tool and Machine Co. is a family-run, general-purpose machine shop. The business originally designed and manufactured special-purpose machinery and printing presses, and has evolved to produce precision machine tool components to print from castings, forgings, and raw stock. The company services 30—35 original equipment manufacturers (OEMs) in Western New York. Printing and specialized machinery volume has declined to the point of repair work and an occasional spare part build. Buerk Tool now is a job shop, and likes its reputation for being flexible with incoming order timing. They generally pursue specialized projects, where garage type shops cannot compete effectively. Their strategy has been to service an existing customer base rather than develop new business.

Buerk Tool's manufacturing facility is contained within a 23,000-square-foot area of a two-story building that they own. They use a broad range of machinery and processes, including jig boring, grinding, computer numerically controlled (CNC) turning and milling, horizontal bore machining, and manual lathing and milling. A wide range of parts and part sizes are produced, which adds to the complexity of order tracking and material storage.

Buerk Tool employs 14 people, 11 of whom are production personnel. The management team consists of Richard Buerk President, Owner; Don McCourt, Plant Manager; and Kevin Foley, Methods Engineer. A small clerical staff supports the business. The shop is non-union, and machinists are routinely moved to various tasks on an as-needed basis. The labor force is experienced and turnover is low. The outside sales force consists of Mr. Buerk and two manufacturer representatives.

Technical Assistance Provided

Buerk Tool was Reminded of TDC Services at Just the Right Time. For some time prior to the first project assistance it provided the company, the Western New York Technology Development Center, Inc. (WNYTDC) and Buerk Tool had known one another. In fact, TDC has record of a visit to Buerk Tool in 1993 and, according to Mr. Buerk, had actually been in touch on many occasions. Mr. Buerk was also a personal acquaintance of TDC's president from the days when he served as chairman of a local small business development association. Until 1995, however, TDC did not provide Buerk Tool with any substantial services.

In early 1995, Mr. Buerk recognized that his plant was struggling. The shop floor had long been choked with scrap and obsolete equipment. An upswing in orders exacerbated layout and clutter problems by adding piles of work-in-progress to the shop floor. It became difficult to walk through the shop, let alone maneuver forklifts. At least one key area was truly impassable to the forklifts, such that the work

would be piled on the floor and then carried to specific machines piece by piece on hand carts.

It was at this point that Mr. Buerk attended a presentation by Bob Martin, the president of TDC, describing the manufacturing services that were available from TDC. Mr. Buerk viewed TDC anew in light of his current problems, and requested a site visit. John Murray, Project Manager and Alan DeForest, Project Engineer of TDC, paid Buerk Tool a visit and helped them focus on specific areas in need of change. This initial assessment targeted manufacturing machine placement, housekeeping, and inventory control as the areas poised to benefit most from significant improvements.

TDC Staff Spent 80 Hours Assessing the Shop Floor and Crafting New Plans. TDC provided direct technical assistance to Buerk Tool over the course of five months. Mr. Murray and Mr. DeForest spent 80 hours working with Buerk Tool. The project team of DeForest, Murray, Buerk, Foley and McCourt met at least once weekly. TDC services were provided to Buerk Tool for a total fee of $2,800.

Mr. DeForest took the primary service provision role at Buerk Tool. With professional expertise in plant layout and workflow analysis, he was well-suited to the task. Representatives of Buerk Took stated that receiving an outside opinion was a vital precursor to change. Moreover, Mr. DeForest was immediately respected and was soon afforded the trust required for a major plant overhaul.

TDC formed an interdisciplinary team of Buerk Tool employees to collect and analyze data and to recommend process and layout improvements. The team met weekly. At the conclusion of each meeting, action items were assigned to team members, who were then responsible for their completion. Through this process, the company gained the commitment of their employees for the proposed changes.

The primary component of TDC's work was a computer-aided design (CAD) analysis of the workflow of jobs through Buerk Tool. Using the records from a random sample of 14 recent Buerk Tool jobs, Mr. DeForest simulated the workflows of these jobs through the plant, both quantitatively and visually. He then devised two alternative layout schemes to minimize the travel distance for these jobs. These optimization models accounted for a number of constraints, including the locations of large milling and lathe machines with independent concrete foundations that could not be moved.

To assess the importance of specific machines, Mr. DeForest analyzed previously collected machine utilization data. In most cases, analysis confirmed existing suspicions that machines were underutilized. The analysis also demonstrated that under-used machines were taking up key floorspace.

TDC presented Buerk Tool with a variety of recommendations to improve their production area, including housekeeping procedures, tool and materials storage, a new bay door to improve product flow, and better utilization of floor area. For each layout and process change proposed, the

TDC engineer presented the company with an independent study demonstrating the effectiveness of similar changes at other facilities. This process helped convince the Buerk Tool management team that these major layout changes had promise, so they accepted the entire plan.

TDC Introduces Buerk to Job Boss™. In the spring of 1995, TDC referred Mr. Buerk to a National Technology University seminar on industrial manufacturing information systems. Through this seminar, Mr. Buerk was exposed to Job Boss™ work tracking software and became convinced of its applicability to his plant. As a result, Buerk Tool has begun using Job Boss™ and will soon be running it on a local area network linking the shop floor and offices.

Changes in Practice

Major Changes on the Shop Floor Result in Major Changes in Staff Activities. Although implementation of the plan is not yet complete, observers inside and outside the plant report major changes in the form of new practices, both in the shop and office.

- As a result of changes in the plant layout, material handling time has been reduced, and the distance that materials move from start to finish has decreased. The effect is a decline in work-in-progress inventory.

- Improved housekeeping procedures, which included removing or reducing the quantity of underused or unused machinery, scrap, and work-in-progress, have further improved work flow.

- Multiple observers, including customers, already have noted a dramatic improvement in housekeeping throughout the shop. This improvement is the result of efforts by the entire shop staff. While TDC has recommended the hiring of a utility person for cleanup, the shop thus far managed to achieve improved housekeeping with its existing staff. Similarly, the storage of hand tools has improved.

- Installation of a new overhead door has enabled more efficient removal of scrap and spent oil from the shop. This door is planned as a new shipping point when other layout changes are in place. Use of the new door will allow a more direct flow of work through the building and avoid the dual use of a single bay for both receiving and shipping.

- A new workspace has been created in what was formerly a loading and storage bay through the installation of a new radiant heating system. This workplace now houses a large saw relocated from the main shop floor.

- The Plant Manager has more time to spend planning and scheduling production and delivery at the beginning of the operation; the Process Engineer has more time to attend to manufacturing issues.

- Through the sale of old machines, Buerk has generated $2,200. In addition, some of the scrap that had accumulated above the machine shop has been sold.

Buerk Tool was principally responsible for implementing the new layout. Following completion of the layout and process improvement plan, Buerk Tool was principally responsible for implementation. While the process was more difficult than predicted, follow through has been excellent. Most staff members have been involved in the cleanup and moving process. Through careful planning, Buerk Tool avoided major work disruption. A professional industrial rigger was hired for all major machine movements.

The first machine was moved in October 1995, just days after the layout plan was finalized. By December, half of the relocation work had been completed.

Other recommendations are currently being implemented, including the use of Job Boss software, bar coding for the traveler sheets that accompany specific jobs through the shop, and the installation of the LAN.

Changes in Manufacturing Performance

According to Mr. McCourt, without TDC, "...we would just be plodding along the same as always, some years making money, some years in the red." According to Buerk Tool staff members, process flow improvements will reduce production costs, speed delivery time, improve shop safety, save costs by freeing up space, free up managers' time for more productive activities, and improve the appearance of the shop to customers.

Process flow improvements will reduce production costs. A major impact of the project will be cost savings as a result of reduced product movement through the shop. With the relocation of machines, the movement of a product from receiving to shipping will be substantially reduced. For example, one job moved 328 feet prior to assistance; after the project is completed, its movement will have been reduced to 122 feet. The average movement reduction calculated for a sample of 14 actual jobs was 30 percent. Clearly, every eliminated movement of work and personnel through the shop will reduce the time required to complete a job. This will help Buerk Tool both reduce production cost and increase delivery speed to customers. Future implementation of a data collection process will enable Buerk Tool to calculate production costs and cost savings associated with the process improvements.

...Speed Delivery Time. The movement of machines and reduction of clutter has opened shop floor aisles. Cleared work surfaces have made tools easier to find. This will further speed movement of product through the shop and improve overall throughput and on-time delivery rates.

...Improve Shop Safety. For many processes, product and stock materials (rods, tubing, etc.) are carried through the shop by hand. Other moves are made on hand carts and forklifts. In all cases, cleared aisles will improve the overall safety of the shop. Moreover, housekeeping improvements, including the removal of oil from the floor, will further improve shop safety.

...Save Space-related Costs. With the new layout, some 1,360 square feet of floor space has been freed up for productive uses. Given total utilization, the value of the space is approximately $5 per square foot, for a total value of about $6,800. This would have been the cost if Buerk Tool had purchased new space rather than freeing it from existing space.

...Free Up Managers for More Productive Activities. Managers report that shop floor improvements will allow them to focus more of their attention on other matters. Mr. McCourt reports he will have more time for up-front job planning efforts. Mr. Foley says he will have more time to interact with customers and bring in additional work. Every hour of extra attention to these matters will save Buerk Tool money.

...Improve the Appearance of the Shop to Customers. According to Mr. Foley, at least one customer has already seen the shop floor and remarked on the new cleanliness and orderliness of the workshop. To the extent that customers are exposed to the shop floor and are impressed enough to increase their business with Buerk Tool, sales may increase as a result.

...And Make the Whole Organization Less Resistant to Change. The president of Buerk Tool is now willing to begin removing machines from the floor. "I had a love affair with certain machines," reported Mr. Buerk, "but Al talked me into getting rid of some." Causing Mr. Buerk particular anguish was the elimination of a particular lathe—one of the first CNC lathes ever produced with a vacuum tube-driven controller as large as a filing cabinet. The lathe was rarely used, however, and its removal opened a large space in the middle of the shop for a new machine. This new machine has unique capabilities which will afford Buerk Tool a capacity not shared by many of its competitors.

Business Outcomes

Buerk Tool had a record year in 1995 and attributes much of this to TDC. In 1995, Buerk Tool sales increased 20 percent over the previous year for record sales of $1.4 million. Mr. Buerk attributes 17 percent of the increase (85% of the total change) to the efforts of TDC. He reports that through increased shop capacity, additional orders could be filled. He believes Buerk Tool would not have been able to take advantage of increased demand without TDC's involvement: "Without the assistance nothing would have happened. We would have continued repeating the same behaviors and expecting new outcomes." Mr. McCourt concurs, saying that without the changes, "We would not have been able to respond as well to the upswing."

Mr. McCourt reports that the market is very competitive. For certain jobs, "There are lots of small shops that can undercut Dick's price." The staff hopes that the addition of new machines, for which there was previously no room, will increase Buerk Tool's specialization, job capacity, and general competitiveness. CNC programmer John Regensdorfer put it simply, "If we get new tools, we can do the job faster, which costs less money, which means we can keep our jobs."

Given the will to grow, Buerk Tool has great capacity: They have a very large work space and over 50 machines operated by only eight workers. If increased sales continue, Buerk Tool has substantial potential for hiring new employees.

In the meantime, the employees of Buerk Tool received a 5-percent wage increase and a 15-percent bonus this year in response to the plant's strong performance.

Competing Explanations

A case can be made that the increased sales Buerk Tool experienced in 1995 were principally the result of increased demand from a strengthened economy. However, Mr. Buerk contends that the plant could not have *responded* to this upswing as effectively without assistance.

While Mr. Buerk attributes 85 percent of the company's 20 percent sales growth in 1995 to TDC efforts, the link may be weakened by the fact that project implementation is not yet complete. However, many staff members attested to the great improvement in work flow through the shop that had already taken place.

Developing the Big Picture

Over the years, Buerk Tool staff had become aware of several problems in its manufacturing operations and had addressed them individually. TDC offered a more global perspective to Buerk Tool management, demonstrating the interdependency of its processes and the importance of maximizing capital utilization. An example of ineffective use of capital and only partially developed planning strategies was the purchase of a new 20-inch radius swing lathe. There was no plan to maximize its utilization and the machine's placement was dictated solely by available floorspace.

Perhaps the biggest long-term impact of TDC on Buerk Tool will be to increase the company's interest in change. Mr. Buerk characterized this interest as a change in the "culture" of the organization that has the management team and machinists alike taking a renewed interest in strategic issues. In discussing with Buerk Tool the company's situation, TDC had argued that new practices were desirable, possible, and ultimately profitable, and thus helped Buerk Tool recognize that change was necessary for everyone, including the president. According to Mr. Buerk, "You know, I think the best result of the project we did with TDC is an attitude change in our people. There is less resistance to change now. Now they buy into the process because they're seeing the improvements."

The challenge is to maintain an environment that fosters continual improvement. Although TDC involvement is now "trailing off," Buerk Tool staff are confident they are headed in the right direction. TDC's role is to monitor the company's performance and implementation of changes.

Case Study

CARVER PUMP COMPANY

Muscatine, Iowa

IOWA MANUFACTURING TECHNOLOGY

CENTER

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Carver Pump Company

Carver Pump Company (Carver) manufactures standard and custom pumps for commercial and military markets. Established in 1938, the company now employs 126 workers on sales of less than $20 million. Carver operates out of a single facility in rural Muscatine, Iowa.

ISO Implementation Assistance

Carver built its initial business on supplying centrifugal pumps to the Navy. By the early 1990's, it received about 70 percent of sales from the defense industry. In response to declining defense industry orders, Carver wanted to enter growing commercial markets in Europe and bid on contracts from certain large U.S. manufacturers. These potential new commercial customers required their suppliers to be certified to the ISO-9000 quality standard.[1]

Technical staff from the Iowa Manufacturing Technology Center[2] (IMTC) had been contacting Carver on a regular basis. In one of those meetings, Carver's president asked about ISO-9000 certification. Two Iowa MTC engineers began to work with the company in the fall of 1993.

The Iowa MTC engineers provided 250 hours of assistance over the 16-month certification period including the following:

- Interpreting ISO specifications.
- Providing a gap analysis, which compared Carver's current quality manual and other documentation to ISO requirements.
- Arranging meetings with six other similar manufacturers in the region that were undergoing or had completed ISO certification.
- Providing training, including assisting with training of all Carver employees in the ISO-9000 standard.
- Structuring Carver's documentation to focus on certain important operational areas, thereby minimizing the amount of documentation.
- Conducting a pre-assessment audit of Carver's documentation just before the official ISO-certification audit.[3]

Carver spent about $80,000 to become certified. To implement the system, Carver hired and trained an ISO coordinator, formed a management steering committee, selected a registrar, and developed and executed an implementation plan.

ISO Certification Obtained

Carver received ISO-9001 certification for the design and manufacture of specialized process, industrial, and marine centrifugal pumps on April 17, 1995.[4] It was the first company in Muscatine to become certified. The process took 16 months, much less than the 24-month average time for companies in Carver's size class.[5] Carver management attributes this time savings to the assistance received from Iowa MTC engineers, as well as to management commitment, low employee turnover, and experience with compliance to military quality standards.

New Skills for Staff, Stronger Regional Relationships among Firms

Carver staff gained new skills and other benefits as a result of implementing the ISO standard. Training each employee to the standard enhanced "employee buy-in" to the process considered critical to attaining certification. Expenditures on training rose from virtually nothing to about $50,000, 40 percent of which went for ISO certification training. Communication was also improved, particularly among employees in order entry and contract review, and in engineering and design control areas.[5]

The meetings linking Carver to other ISO-certified manufacturers in the region helped Carver staff learn "the pitfalls of implementation" and provided insights that "opened the Carver Pump managers' minds, allowing them to interact with other managers of the same functions to solve implementation problems."[5] Carver, in turn, became a resource for other small manufacturers in the region to obtain assistance with ISO-9000 implementation issues. One Davenport, Iowa, manufacturer had deferred implementation until meeting with Carver representatives. That company has since become certified.

New Commercial Markets and Export Sales

Carver's sales composition substantially changed following ISO certification. For the first time, the company could bid on Westinghouse Electric Corporation business available only to ISO-certified suppliers. Carver management estimates that this business, which currently amounts to $70,000 in sales, could rise to $300,000 or more.

Carver also received its first export business. Just before becoming certified, Carver received orders for turbine pumps totaling nearly $200,000 from Italian manufacturer Ansaldo.[5] Company officials do not believe they would have received this order were they not approaching certification, and believe, more generally, that certification is necessary to compete successfully in export markets. Currently, Carver also is bidding on business from a German manufacturer and is working with an Italian manufacturer to jointly design larger high-pressure pumps for worldwide distribution. Carver estimates that about 5 percent of its sales are now export-related, with that share expected to rise to 15 percent in the next few years.[5]

These efforts contributed to a reversal in the percentage of sales to military and commercial markets. Today, about 70 percent of Carver's sales come from commercial customers. This change has maintained the stability of Carver's sales levels in the face of a 40-percent decline since the late 1980's in orders from key military customers like the Navy. Table 1 summarizes these benefits.

Importance of Ongoing Assistance to Small Manufacturer Success

Carver management does not believe the plant could have become certified without outside help, contending that it could not have afforded most private consultants. More significant was the ongoing assistance that Carver received from the Iowa MTC engineers throughout the 16-month implementation period. Carver's president said, "Consultants usually come in and leave, and the small manufacturer doesn't know what to do. The Iowa MTC engineers worked with us like they were part of the company. They had rapport with our employees. They knew 90 percent of the employees by name. That's so important."[5]

Table 1
Training and Sales Benefits from Iowa MTC Assistance with ISO Certification

Benefit Area	Before Iowa MTC Assistance with ISO Certification	After ISO Certification
Training	Virtually no formal training ISO-related training	• $20,000 investment in
Commercial sales	30 percent commercial 70 percent defense-related	• 70 percent commercial 30 percent defense-related
Export sales	Virtually no export sales	• 5 percent export sales (including nearly $200,000 to an Italian manufacturer)

CHRONOLOGY OF SERVICES

July 1993	• Initial meeting held between Iowa MTC and Carver Pump Company (Carver).
September 1993	• Carver hired ISO-9000 coordinator.
	• Iowa MTC reviewed Carver quality control manual against ISO-9000 requirements.
October 1993	• Iowa MTC conducted gap analysis/readiness audit.
	• Carver formed ISO management steering committee.
November 1993	• Iowa MTC helped Carver plan its implementation strategy.
	• ISO coordinator attended week-long lead assessor course.
	• Iowa MTC arranged for Carver to begin visiting other certified companies to obtain implementation assistance.
March 1994	• Carver chose Intertek Services Corporation (Intertek) as th registrar.
July 1994	• Iowa MTC conducted Internal Auditor training.
August 1994	• Iowa MTC and Carver's ISO coordinator trained all employees in the ISO standard.
November 1994	• Documentation assistance was provided by Intertek.
February 1, 1995	• Carver presented pro forma invoice against letter of credit for sales to Italian manufacturer, Ansaldo, upon condition of ISO certification.
	• Documentation audit conducted by Intertek.
March 1995	• Preassessment audit conducted by Iowa MTC.
April 1995	• Formal certification audit conducted by Intertek.
April 17, 1995	• Carver Pump Company received Certificate of Approval from Intertek.
June 14, 1995	• Carver Pump Company held open house to mark ISO certification.
July 1995	• Carver Pump Company management met with Davenport, Iowa, manufacturer to provide assistance with ISO implementation issues.
February 1996	• Sales order acknowledgments sent to Westinghouse Electric Corporation.

ENDNOTES

1. Interview with president and CEO, Carver Pump Company, April 22, 1996.
2. Services for this project were provided through the Center for Industrial Research and Services (CIRAS) at Iowa State University, a partner organization within the Iowa MTC program.
3. Interview with Iowa MTC project team, March 29, 1996.
4. Intertrek Services Corporation, Certificate of Approval 95-370, April 17, 1995.
5. Sheila McKenna, "Kudos to Carver Pump: Certification opens up access to world markets," *Saturday's Journal,* No. 108, May 6, 1995, p.1.
6. Interview with ISO coordinator, Carver Pump Company, April 22, 1996.
7. Verl Anders and Don Brown, "Carver Pump earns ISO-9001 certification," *CIRAS News*, vol. 29, no. 4, summer 1995, p. 7.
8. Pro forma invoice used to present againstletter of credit to Ansaldo GIE, Italia, Italy, February 1, 1995.
9. Sheila McKenna, "Kudos to Carver Pump: Certification opens up access to world markets," *Saturday's Journal*, No. 108, May 6, 1995, p. 5.
10. Interview with president and CEO, Carver Pump Company, April 22, 1996.

Case Study

CENTURY AERO PRODUCTS INTERNATIONAL, INC.

Los Angeles, California

CALIFORNIA MANUFACTURING TECHNOLOGY

CENTER

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Century Aero Products International, Inc.

Century Aero Products International, Inc. (CAP) has been delivering airplane luggage containers to commercial airlines for 10 years. Despite fierce competition, this Los Angeles-based manufacturer was able to penetrate the market and grow its market share because of the container's specially patented interlocking joints. Compared to other container designs, CAP's containers require less time to assemble and disassemble, and do not require any new parts—such as bolts—to reassemble. With its staff of 50 employees, CAP had annual sales last year of $7 million. Currently, 24 airlines use 30,000 of CAP's containers for their daily operations, accounting for around 15 percent of the total market.

CAP Cites Need to Expand Product Line

Like most smaller manufacturers, CAP's CEO, Mr. Ted Dunwoodie, wanted to expand his company's product line to increase CAP's sales volume. The challenge for CAP was to locate and hire the right team of people to develop new marketable products, and to find the funds to pay them. Meanwhile, in the wake of a number of high profile terrorist bombings, the Federal Aviation Administration (FAA) decided that airline containers needed to be more bomb-resistant. To accelerate the development and manufacture of such containers, the FAA put out a solicitation offering to test and subsidize the development of airline containers with the potential to meet the FAA's new, more stringent bomb blast specifications.

CMTC Identifies Opportunity, Works on FAA Proposal

Rick Fingerhut, a field engineer at the California Manufacturing Technology Center (CMTC), was aware of the FAA's interest in facilitating the development of bomb-resistant containers. He took the initiative to make some calls to the FAA in June 1995, to learn the status of the FAA's recommended and required container specifications. As a result of his calls, Mr. Fingerhut learned that the FAA was planning to put out a solicitation for organizations to design a cost-effective, bomb-resistant container. Having recently completed a technical assistance project with CAP, Mr. Fingerhut was aware of the company's production capabilities, and proposed that he help it come up with a proposal to win the solicitation.

CAP was initially skeptical about competing in the FAA solicitation. The company felt it did not have the time or the financial resources to find suitable partners to develop an improved container. Other organizations likely to submit proposals were much better financed and had knowledgeable in-house staffs that were more familiar with the industry's R&D resources, such as suitable product testing facilities. Finally, after a number of

conversations, CAP contracted Mr. Fingerhut to assist it with the activities associated with submitting a proposal to the FAA.

An engineer with substantial experience in the composites industry, Mr. Fingerhut first identified the resources necessary to redesign the existing container to be bomb-resistant. His initial search led him to a number of potential organizations, from which he chose a subset based on their skills and price. Mr. Fingerhut settled on a team of three manufacturing partners to work with CAP: a fiber manufacturer, a composite material manufacturer, and a blast mitigation material supplier.

To give the proposal even more credibility, Mr. Fingerhut collected and analyzed past test results of similar CAP products, and arranged for additional product and materials analysis at Lawrence Livermore Laboratory, a Department of Energy facility with extensive experience in blast mitigation testing. Mr. Fingerhut initially envisioned one of the partners or a think tank to actually coordinate the team and write the proposal to the FAA. However, he was disappointed to learn that each potential coordinating organization wanted a prohibitively high project fee ranging from $100,000—$200,000.

Consequently, Mr. Fingerhut and CAP mutually agreed to collaborate in developing the FAA proposal themselves. The cost to CAP of Mr. Fingerhut's assistance was less than $10,000.

CAP Wins Competition to Prototype New Bomb-Resistant Container

Mr. Fingerhut and CAP submitted their proposal to the FAA just before the February 16, 1996 deadline. A few weeks later, CAP learned that it had won the competition, beating out the six other proposals and receiving the highest ranking on each of the FAA's eight evaluation criteria.

CAP Designs and Builds First Prototypes

After winning the competition, CAP asked Mr. Fingerhut to play a role in implementing the proposal. Over the next few months, he worked with CAP and the rest of the project team on a number of technical issues involving the physical design of the container and the selection of a bonding material that would hold the layers of the container's paneling together. As of May 1996, CAP was on schedule to deliver the first 10 of its prototype containers to the FAA. Over the next 18 months, it will deliver an additional seventy or so containers.

CAP Reaps Initial Benefits, Virgin Market Awaits

CAP will sell approximately $1.5 million worth of airline containers to the FAA as a result of winning the solicitation. Assuming that subsequent tests confirm the initial testing results, CAP predicts that total container sales will be $20 to $40 million over the next 5 years. If, by then, the FAA requires all planes to be retrofitted with bomb-resistant containers, then CAP is positioned to achieve annual sales of around $50 million.

Public to Enjoy Enhanced Airplane Safety at an Affordable Price

For the flying public, CAP's new container will enhance air safety by greatly reducing the risk that a bomb detonated in a piece of luggage will destroy an aircraft or even harm the passengers sitting in the passenger compartment above. Another advantage of the new container is its weight, which is similar to that of containers in use today.

Earlier bomb-resistant prototypes, which weighed over twice as much as existing containers, would have cost far more for airlines to purchase and use. The comparatively low weight of the CAP container is good news for the airlines and the public, given that around 90 percent of the container's operating cost is attributable to the fuel cost associated with transporting it.

Case Study

CHERAW YARN MILLS, INC.

Cheraw, South Carolina

SOUTHEAST MANUFACTURING TECHNOLOGY CENTER

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

English Drews

Southeast Manufacturing Technology Center

Columbia, S.C.

CASE STUDY

Cheraw Yarn Mills, Inc.

Cheraw Yarn Mills, located in Cheraw, South Carolina, is a family-owned business established in 1917. Over the years, Cheraw has progressively grown and expanded to become a manufacturer of synthetic and blend quality yarns, with 275 employees and annual sales of $50 million. Most of Cheraw's customers are located in the eastern region of the United States. With increased competition, particularly from Pacific Rim countries, for this slowly growing domestic commodity market, Cheraw was intent on maintaining a world-class operation that produced quality products.

The Challenge

Since 1989, Cheraw has been committed to continuous improvement programs such as total quality management (TQM), team building, capital investments, and customer partnerships to protect its domestic market. However, the rise in cotton prices and increased operating costs, along with slowing U.S. demand, was making competitive performance critical to survival. In addition, Cheraw was interested in exporting. Malloy Evans, president of Cheraw Yarn Mills, realized that to continue to be competitive, the company needed to move to the next level of performance.

ISO registration appeared to be an option to build and strengthen the company's position; however, Mr. Evans and his staff perceived it to be too expensive, too cumbersome, and too time consuming, with limited chance of success. They were also concerned that ISO-9002 registration (the quality standard appropriate for their business) was just a "rubber stamp" addition to place on a company's stationery. "In a commodity market like ours, without brand identity, we had to know that being ISO-9002 registered would make us a better company," summarized Mr. Evans. The Southeast Manufacturing Technology Center (SMTC) helped Cheraw break this barrier to innovation by demonstrating that ISO-9002 was an affordable, effective solution to help the company maintain its competitiveness. In other words, they couldn't afford not to do it.

The Solution

SMTC's ISO-9000 technical consultant, Mel Stauffer, was eager to coach Cheraw through the ISO-9002 registration process. Impressed by Mr. Stauffer's 100-percent success rate with other small manufacturers, as well as his process and timeline to achieve registration, Cheraw was committed and determined to become ISO-registered by the end of 1995.

To prepare Cheraw for registration, Mr. Stauffer committed two days per month to coach Cheraw through five phases toward ISO-9002. The first phase, Management Overview, created commitment throughout the organization by establishing the implementation team and leaders

for each element within the quality standard. The second phase, Training and Evaluation, trained all employees on the elements of ISO-9002, teaching them how to conduct gap analyses and develop improvement plans for those elements. Phase 3, Compliance, involved documenting Cheraw's management system and establishing an audit procedure to ensure continuous improvement. Phases 4 and 5, Readiness and Registration, involved pre-assessment and preparation for registration.

The Impact

In November 1995, Cheraw became the first manufacturer of sales yarn in South Carolina to become certified to the ISO-9000 standard. The company passed the audit performed by the American Quality Assessors, making Cheraw one of the most efficiently run manufacturers in the state. As importantly, the company has improved its operations in a number of areas, the impact of which has already begun to show.

In January of this year, Cheraw conducted a management review of the quality system. Over 50 percent of areas tracked in a weekly quality report have shown improvements. Customer complaints are down 15 percent, reducing costs by $10,000. A 25 percent decrease in nonconforming product has garnered a savings of $30,000. Supplier quality assurance procedures have led to a stricter evaluation (and in some cases elimination or probation) of those suppliers. "It is pretty clear our quality system is improving our capabilities and demonstrating to our customers that we are taking the correct measures to ensure our product meets or exceeds their needs," stated Robert Angle, quality assurance manager for Cheraw.

Cheraw is considering expanding its product line and, based on the ISO certification, intends to attract a broader customer base. Prospects for survival in this competitive industry have improved, and Cheraw has maintained its position as a leader in the sales yarn market. "Attaining ISO-9002 certification has inspired greater pride and confidence in our employees," stated Mr. Evans, "and we have been able to differentiate ourselves against fierce competitors in a commodity market."

Alternative Explanations

In 1989, Cheraw made a commitment to do things differently. The application of TQM principles positioned Cheraw to adopt progressive, modern management approaches and practices. Although Cheraw had also worked with an industrial psychologist from Clemson University in the area of team building, this activity had taken the company as far as it could go. Another resource had approached Cheraw to help it with ISO registration, but was out of the company's price range. SMTC's program was considered affordable, with a shorter implementation schedule and a greater probability of success, based on SMTC's track record. Conceivably, Cheraw could have proceeded with this project and other resources but at a potentially higher cost and longer lead time. The impact and manufacturing improvements that Cheraw realized are directly attributable to the process improvements resulting from ISO-9002 registration.

CHRONOLOGY OF SERVICES

1993	• Became aware of ISO-9000 standard.
1993-1994	• Interaction with Clemson Apparel Research, SMTC partner.
1994	• Became aware of SMTC services for ISO-9000.
March 1994	• Proposal developed and accepted.
April 1995	• Project began.
September 1995	• Project completed.
November 1995	• Achieves ISO-9002 certification.

Case Study

CONSERVATION ALLIANCE, INC.

Southbury, Connecticut

CONN/STEP

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Tab Wilkins

CONN STEP

New Britain, Conn.

CASE STUDY

Conservation Alliance, Inc.

Conservation Alliance, Inc. (CAI), based in Southbury, Connecticut, designs and sells replacement exit signs using Light Emitting Diode (LED) technology. Current annual sales are under $2 million. CAI manages a network of Connecticut subcontractors to engineer, manufacture, and assemble the exit sign units. Signs are sold directly to large end users or through energy service companies for installation in colleges, universities, school systems, government facilities (such as the Kennedy Center in Washington, D.C.), and commercial offices.

The Market

The total U.S. exit sign replacement market is estimated at 100 million units. While the replacement sign market grew slowly through the late 1980's and early 1990's, the growth rate rapidly increased in recent years with the emergence of modern technologies that reduce energy consumption and costs.

Typically, building codes mandate the installation of thousands of exit signs in public buildings. LED-based signs can offer substantial energy costs savings—up to 98 percent—compared to older incandescent designs. Replacement signs typically pay back the investment in 18 to 24 months, representing a real cost savings for building managers pursuing low-cost capital improvements.

New LED technologies, sophisticated electronic circuitry, and new manufacturing approaches have helped fuel recent growth in the replacement market. The handful of large companies manufacturing exit signs for new construction is now moving into the replacement market. Up to 20 smaller manufacturers have entered the replacement market during the last 5 years.

In the past, replacement exit sign purchases typically had been part of larger contract renovation efforts, with price being the primary selection factor. More recently, however, failures experienced among lowcost units have made quality the decisive market factor. CAI's desired niche is to manufacture a reasonably priced sign with superior quality.

Problem Identification and CONN/STEP Assistance

The main issue confronting CAI was whether to compete in the replacement sign market or to go out of business. The company needed a strategy to deal with the increasing customer demand for quality and the combined lower prices of competitors. CAI sought outside guidance and support in meeting these needs and in selecting a course of action.

The company originally contacted CONN/STEP in August 1994, after attending a presentation by Jake Mendelssohn, the regional field engineer. At

this time, the company had been operating for about 2 years, with annual sales of approximately $500,000. The two specific issues for CAI were reducing manufacturing cost and, ultimately, price, while ensuring or improving reliability in the electronics. With reasonable strategies in hand, CAI would continue to operate in Connecticut.

Initially, two projects were identified: one to adopt injection molding as the basis for manufacturing major sign components, and the other to extend the life of the exit sign circuitry. The company also implemented a new supplier management strategy, and has initiated development of a sign retrofitting kit by redesigning the attachment base.

Adopting Injection Molding. One initiative aimed at reducing manufacturing costs was to change materials and overall manufacturing processes. The idea of using plastic in place of metal components was first discussed when CAI considered bidding on a Navy contract that required non-corrosive materials for coastal locations. Plastics offered protection from corrosion and the ability to reduce the number of components, reduce production costs through volume, increase sign durability, improve optical diffusion, and reduce weight. However, CAI had no experience or knowledge about working with plastics.

CONN/STEP helped by conducting a preliminary materials selection and by counseling CAI through the pros and cons of adopting plastic injection molding materials and processes for all of their exit signs. CONN/STEP located companies that could develop and create the tooling and dies needed for this new manufacturing approach, and provided support and counsel as CAI interviewed potential suppliers in September 1994. CAI elected to work with Livesy Mold and Manufacturing, which completed the materials selection, tooling, and dies by February 1995.

Extended Exit Sign Life. Some of CAI's competitors offered a guarantee of 10 years, prompting CAI to offer a guarantee of 10 years for its product. Superior quality had gained prominence in the marketplace, and guarantees and reliability had become important selling points. The field engineer conducted a preliminary review of the electronic circuitry, and identified several problems needing correction if CAI wanted to guarantee its signs for 10 years. CAI also wanted to improve the efficiency and optical qualities of the LEDs, and to verify its claims about the circuitry with legitimate documentation.

CONN/STEP again identified outside expertise and was able to help CAI review electronic circuit designers capable of meeting its needs. CAI elected to work with Ciarcia Design Work, beginning in November 1994, to develop the board circuitry. The project was completed in December 1994.

Supplier Management Strategy. As part of its overall improvement effort with CONN/STEP, CAI hired a person to locate and qualify more reliable subcontracted suppliers. CAI negotiated better prices and delivery dates, and developed a long-term supplier management strategy.

Ongoing Initiative: Development of Retrofitting Kit. An additional project CONN/STEP is currently undertaking with CAI is developing a new retrofitting kit to enable a facility to install and convert to the CAI sign without undergoing a complete renovation. CAI expects this product to greatly expand sales.

Resources Committed. The field engineer, through September 1995, had committed a total of 51

hours to the company, helping it select a new manufacturing process and understand the possibilities of new circuitry designs. The field engineer also located technical expertise for CAI, helped it select various experts, and secured CONN/STEP contracts for two successfully completed projects.

Livesy Mold and Manufacturing and Ciarcia Design Works together provided a total of approximately 200 hours in outside consulting expertise, the cost of which totaled $22,000.

Changes in Practice and Performance

With CONN/STEP's assistance, CAI was able to select a specific plastic material to meet its needs. The plastics approach to manufacturing required a $75,000 investment in new tooling and capital equipment. A new circuitry design was developed and adopted by CAI for its product, ensuring the legitimacy of its 10-year guarantee.

With the use of plastics and injection molding, CAI was able to improve its output by a factor of 5—up to 200 signs per day—and reduce its manufacturing costs by 50 percent. Injection molding reduced the number of parts, assembly steps, and manufacturing costs, while improving durability and the optical diffusion of the display.

The electronics improvement project easily extended the life of the signs to 10 years. Without this achievement, CAI believes it would have failed in the marketplace.

In addition, CAI experienced a 50 percent reduction in overall product cost, and, of that, half was due to the new supplier management strategy.

As a result of these changes alone, CAI increased its ability to compete on various contracts for the manufacture of exit signs. Costs per unit were lowered and quality was improved. CAI also could demonstrate with confidence the 10-year reliability of its signs. As purchasers became aware that cheaper signs did not last, CAI was able to win more contracts, not as the low-cost provider, but as the quality provider. Consequently, the company doubled its sales in 1995 compared to 1994.

Public Benefit

Without CONN/STEP's help, particularly on the circuitry, CAI might have gone out of business. Instead, CAI estimates it has added approximately 12—15 jobs to its Connecticut-based manufacturing and assembly operations. Its growth will benefit its Connecticut suppliers as well. For example, the recent doubling of CAI's sales has created or saved approximately six to seven jobs at supplier firms.

Moreover, CAI helped save at least four additional jobs in Connecticut. A Connecticut-based assembly house had just lost a large contract with a major firm that was moving its assembly operations to South America. The assembly house would have closed except for CAI's expanded work and modification of its supplier management practices. Further, within the year, the major firm brought work it had been outsourcing to South America back to Connecticut because of quality problems.

Finally, CAI's progress has:

1) increased corporate taxes for the State of Connecticut, in part through new capital investment in equipment, tooling, and dies; and

2) increased state income tax revenues by creating or retaining a sizeable number of in-state jobs.

CHRONOLOGY OF SERVICES

August 1994	• Conservation Alliance contacts CONN/STEP for initial site visit after attending Field Engineer presentation.
August 1994	• Three injection molding companies are contacted and reviewed by CAI and the Field Engineer.
August 1994	• Field Engineer undertakes research for CAI on comparing Light Emitting Diode brightness, lifespan.
September 1994	• Injection Molding project initiated with Livesy Mold and Manufacturing.
September 1994	• Field Engineer begins to work with potential service providers for electronic circuitry analysis.
November 1994	• Second project examining electronic circuitry of the sign is initiated.
November 1994	• Helped company to locate contract assembly houses in Connecticut that could support the plastic injection molding assembly operations.
December 1994	• Second project on electronic circuitry is completed, new design implemented, and documentation completed.
February 1995	• CAI project in injection molding is completed.
March 1995	• New design and manufacturing capabilities are implemented.
May 1995	• Third project undertaken to design new replacement kit.

Case Study

CUSTOM MATERIALS

Cleveland, Ohio

GREAT LAKES MANUFACTURING TECHNOLOGY CENTER (GLMTC)

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Carol Lucas

Cleveland Advanced Manufacturing Center

Cleveland, Ohio

CASE STUDY

Custom Materials

Located in Chagrin Falls, Ohio, southeast of Cleveland, Custom Materials (Custom) manufactures electric product components. The company employs 100 people and recorded $10 million in sales in 1994. Its subsidiary, Custom-Pac Extrusions, Inc., is located in Cleveland. The company's market stretches from Canada to Mexico and clients include such major players as Reliance Electric, General Electric, and Westinghouse.

Impetus to Change

About 6 years ago, Greg Robinson, Custom's president, was beginning to feel pressure from his competition and his customers to improve the company's product quality and manufacturing practices. Mr. Robinson said he sensed "a tidal wave" coming at him as his major customers started to inquire about the company's plans for ensuring total quality, reducing costs, and improving delivery, services, and products. One million-dollar customer even told him to improve his quality or the customer would take his business elsewhere. His options were obvious: "Either I figure out how to ride this tidal wave, or it will wipe us out." That is when he encountered the Great Lakes Manufacturing Technology Center (GLMTC) in Cleveland and began an ongoing relationship to discover the technology and techniques to bring about needed improvements.

In the quest to find new ways to implement old ideas, Custom's president had to learn some new concepts that were foreign to him. Having gone into the business with his father-in-law, Mr. Robinson said he did not expect to have to develop a business system for an organization "where all the employees already know what they're supposed to be doing." But he knew that something had to be done, or he would start to lose business.

Introduction to GLMTC

Mr. Robinson discovered GLMTC at a breakfast meeting featuring the CEO of Reliance Electric Company, one of Custom's customers, as the guest speaker. "I became intrigued with what GLMTC had to offer," he recalled, and asked for a GLMTC Strategies for Increasing Your Total Effectiveness (SITE) operations assessment. He was pleased with the results. Expecting a three-page report, Mr. Robinson was amazed when GLMTC delivered a 50-page document detailing everything from management goals and quality assurance to plant layout and management-employee issues.

"I looked at this thing and thought, there's enough here that if I began to work on all these recommendations today, I would have 5 years' worth of work," he said. "Here we are, 5 years later, and I still haven't finished them all." Indeed, the quest became one of continuous improvement for Custom as its relationship with GLMTC grew.

Technical Assistance Provided

Shortly thereafter, GLMTC engineers began working with Custom to develop a quality assurance system. That project was followed by the installation of a new business information system, a new plant layout, a waste reduction project, and an environmental project. Over time, the project list would include areas of quality, gap analysis, and plant layout. GLMTC has assisted Custom with a variety of business systems projects and is currently helping the company with software implementation. In all, GLMTC has provided a total of 33 deployment activities to Custom.

Specific assistance provided by GLMTC included the following:

- Training resource reference
- ISO-9000/EPA/Marketing information
- Advice on implementing EDI
- Injection molding training information
- Bar code information
- Software assistance from the Cleveland Advanced Manufacturing Program (CAMP), GLMTC's host organization and MEP affiliate
- Injection molding troubleshooting
- Synchronous manufacturing information
- Machine selection assistance
- Pattern nesting software
- Pallet changers for computer numerically controlled (CNC) machinery
- Plant layout redesign
- Waste reduction assessment

Outcomes

Custom has experienced many positive impacts on all facets of its operations as a result of GLMTC assistance. These include:

Better Quality Control. Custom has attained a higher quality control standard, and improved the ability of its product to pass new tests. Quality control system improvements have made it easier for the company to get new business, ensure constant quality, and identify scrap and rework issues.

Improved Manufacturing Performance. Physical improvements related to Custom's manufacturing performance include reduced scrap rates, an increased percentage of on-time delivery, better capacity utilization and materials handling, faster set-up times, shorter lead times, reduced inventory size, and less work-in-progress. All of these improvements—most stemming from improved plant layout and faster throughout time—have enabled the company to react faster to customer demands and to improve overall firm productivity. In addition, its enhanced workforce organization and training will help Custom not only sustain these higher performance levels but improve upon them over time.

Business Benefits to Firm. As a result of company-wide manufacturing improvements, Custom has experienced increased production, quality and margin, along with reduced costs and waste.

Intangible benefits include a restored reputation for the company's products, which promises continued expansion of its customer base. Resulting decreases in prices and customer reject rates have also greatly benefited the company.

Given a new sense of direction, Custom has significantly enhanced its annual sales, its annual profits, and its prospects for survival. Mr. Robinson feels that by working with GLMTC to adopt technology improvements, he has readily addressed his operational issues, and thus is better able to capitalize on his market strategies and to position the company to succeed in the industry.

Public Benefits

Custom's success has prompted the creation and/ or retention of jobs, better employee compensation and productivity, and more exports. In a reciprocal relationship with GLMTC, Custom is able to provide honest feedback to GLMTC as it tests ideas for new products, services, and programs.

Beyond Dollars and Cents

Mr. Robinson views his continuous improvement program as a journey. "Once you get going, there's no end to it," he said. "I know we've made a lot of progress. We have a sense of direction and we've had some big accomplishments. We take a lot of satisfaction in that, but know we still have a long way to go."

He noted that his company's progress, direction, and accomplishments, made possible by several manufacturing improvements, go beyond dollar and cents. To make the point, he asks a rhetorical question: "If I had not made these improvements, would I still be in business?" He answers with another: "How do you put a price tag on that?"

Case Study

D. J. MANUFACTURING, INC.

Huntington, West Virginia

THE WEST VIRGNIA PARTNERSHIP

FOR INDUSTRIAL MODERNIZATION

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Lawrence D. Dixon

The West Virginia Partnership for

Industrial Modernization

Montgomery, W.Va.

CASE STUDY

D.J. Manufacturing, Inc.

D.J. Manufacturing, Inc. (DJMI) is a machine shop that manufactures discrete parts for a builder of underground coal mining equipment. The company has 39 employees and it has been located in Huntington, West Virginia, for 32 years. The company's annual sales are approximately $1.75 million. More than 60 percent of the company's business comes from the J.H. Fletcher company, a manufacturer of roof bolters for the underground coal mining industry. In recent years, the underground coal mining industry has experienced some downturns, which caused it to decrease its acquisition of new underground coal mining equipment. This decrease, in turn, compelled DJMI to consider ways to supplement its business even though the company does not have a history of actively seeking additional business. In 1989, the company purchased a computer-assisted design and manufacturing (CAD/CAM) computer system to enhance its capabilities to program seven pieces of numerically controlled (NC) and computer numerically controlled (CNC) equipment. During the start-up phase of this project, the supplier of the CAD/CAM computer system closed its business and ceased to support the relevant system software.

Industrial Extension Assistance

Using a Computer-Controlled Coordinate Measuring Machine. In 1993, Tom Bailey, P.E., the regional West Virginia Partnership for Industrial Modernization (WVPIM) extension engineer, was introduced to DJMI while he was participating as a support resource for a business retention and expansion program presented by the local Chamber of Commerce.

After Mr. Bailey described WVPIM to DJMI, the company requested his assistance in identifying a resource that could help the company develop a patent application drawing of a braking system prototype for a large earthmover. The elaborate shape of the part made the development of an accurate drawing difficult. The company had been unsuccessfully attempting to develop the drawing for some time and its deadline for completion was rapidly approaching.

Mr. Bailey suggested that the part be taken to the coordinate measuring machine (CMM) at the Robert C. Byrd Institute for Advanced Flexible Manufacturing Systems (RCBI). The CMM could transmit measurements made on the part directly to a CAD package. Within a 2-week period, the drawings were successfully produced and provided to the developer of the prototype.

CAD/CAM Capabilities. Successful development of the prototype drawing encouraged DJMI to request further assistance from WVPIM. The second request for assistance was for help in identifying the problems the company was experiencing with its CAD/CAM system.

Mr. Bailey worked diligently with DJMI's staff to develop an in-depth analysis of the problems associated with the company's existing CAD/CAM computer system, identifying problems with hardware and software compatibility, connectivity, and training. After an evaluation of available technical support resources, WVPIM again approached RCBI for assistance. RCBI had well-established capabilities for training and technical assistance in CADKey, AutoCad, and SMARTCAM.

WVPIM and RCBI jointly developed a proposal for new computer hardware, software, and training to meet DJMI's CAD/CAM needs. In addition, RCBI systems engineers visited DJMI's shop to gather information needed to assist DJMI in writing specifications for post processors and hardware connections for all the company's existing NC and CNC equipment.

DJMI agreed with the suggestions in the proposal and purchased the recommended hardware and software. The company also enrolled three of its employees in CAD courses offered at RCBI.

Implementation Phase. The proposal for DJMI included the following phases:

- Recommended hardware and software for its CAD/CAM system
- CAD software training for employees
- CAM software training for employees
- Modification of post processors for the CAM software to be used with the company's shop equipment
- Assistance in the connection of the new CAD/CAM system to each of the company's individual machines

Replacements for "Smart Boxes." As the above phases were being completed, another problem became apparent. The problem occurred because DJMI had several pieces of NC rather than CNC equipment. The programs for the company's NC equipment were on punch tape and the equipment used "Smart Boxes," which are electronic devices used to add memory and communication capabilities to NC equipment.

These "Smart Boxes," which DJMI had used with its earlier CAD system, were not compatible with the new system. This incompatibility problem occurred because the "Smart Boxes" were no longer made or supported, had limited communications capabilities, and came with no documentation on how to communicate with them.

The new CAD system could have been used to generate new punch tapes for the NC equipment, but many of the anticipated advantages of the new system could not have been realized. DJMI would still have been required to maintain its volumes of punch tapes if the "Smart Boxes" could not be upgraded or replaced.

After discussing this problem with DJMI's staff, Zhang Jin, manufacturing engineer for RCBI, began to investigate replacements for the "Smart Boxes." During this investigation, Mr. Jin identified several replacement systems, then requested that WVPIM's Tom Bailey assist him in evaluating the capabilities of each system.

This joint evaluation by WVPIM and RCBI revealed that a system offered by Rybett Controls would likely be the best candidate to fulfill DJMI's computer interface needs. After arriving at this decision, Mr. Bailey and Mr. Jin visited a manufacturing facility where the Rybett System was in use.

Observations of the Rybett System revealed that not only would it satisfy DJMI's fundamental interface needs but it would also provide the company with several new advantages. The Rybett System consists of the following components:

- A communication network that could deliver all programs to the appropriate machine.

- A system for storing all machine programs on computer disk. The programs are now secure because the computer disk can be backed up daily and a backup copy stored off-site. In addition, the machine operators need no longer be responsible for storing volumes of punch tapes at each machine.

- Two remote shop terminals where machine operators can download programs to their machines.

New Manufacturing Practices

Several months after the successful installation of DJMI's new shop program system, the company was able to cost justify the purchase of a new KOMO CNC vertical milling machine (approximate cost: $150,000). The connection of the milling machine to DJMI's new shop program system occurred within the first few weeks of its operation.

The use of the new control software provided the new machine with the same easy access to programs and central storage as DJMI's existing NC/CNC equipment. Programs generated in the company's design station could easily be transferred to the machine. Likewise, program changes made at the machine could easily be transferred back to the design station.

Benefits to the Firm

It is extremely difficult to measure DJMI's cost reduction associated with their CAD/CAM computer system improvements, but the year following the completion of the project the company experienced an 18.6 percent reduction in labor costs while sustaining production levels at approximately the same level as the previous year.

Bert P. Bays, president and CEO of DJMI, stated that it is his belief that a major part of the company's decrease in labor cost resulted from a reduction in plant overtime. Mr. Bays further stated that he directly attributes this reduction in plant overtime to the enhancements that the company made in its CAD/CAM computer system.

Furthermore, when the entire CAD/CAM computer project was completed in 1995, DJMI had a substantial competitive edge. DJMI can take a part drawing created in a CAD system and, utilizing its CAM package, create the programs required to machine that part in a fraction of the time needed to program the machine manually. As a result, the company now starts production of new parts within a week if the drawings for the part were created in-house, and within days when a customer furnishes a drawing file in a compatible format. Lead time to put a new part into production on NC/CNC equipment had taken as long as a month.

DJMI is primarily a production shop, with programs written for over 10,000 parts. The programs previously had been stored on punched tapes and kept at each machine in file cabinets. The elimination of punch tapes was beneficial in terms of security and in shortening the time required to locate the right program. These benefits contribute to shorter set-up times because the appropriate program can now be retrieved by part number.

All in all, the connection made with the local Manufacturing Extension Partnership (WVPIM) was a vital link to services useful in moving a company toward lasting competitiveness and world-class manufacturing status.

Illustrations of impacts are available from the author on special request.

Case Study

EXTRUSION TECHNOLOGY, INC.

Randolph, Massachusetts

MASSACHUSETTS MANUFACTURING

PARTNERSHIP

AT THE BAY STATE SKILLS CORPORATION

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

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CASE STUDY

Extrusion Technology, Inc.

Extrusion Technology, Inc., is a small manufacturer of extruded aluminum parts and assemblies located in Randolph, Massachusetts. The unique aluminum housings manufactured by 60 employees at the company's 50-year-old plant are used in a variety of applications, from modems to fire alarm call-boxes. The production of these housings and other components is dependent on two sets of operations: the extrusion, or shaping, of aluminum billet and the subsequent machining and finishing of these pieces into final products.

When Extrusion Technology's president and owner, James Sharpe, purchased the company seven years ago, it was in a struggle for survival. Over the next several years, he implemented an improvement strategy in an effort to re-establish the company's profitability and, ultimately, transform it into a world-class competitor. The company is beginning to realize the benefit of this continuous improvement effort. In the past two years, Extrusion Technology has enjoyed a substantial 18 percent increase in sales. The Massachusetts Manufacturing Partnership (MMP) has been an invaluable contributor to the company's transformation, assisting in the improvement of its internal communications, productivity, and new product development and marketing.

MMP and Extrusion Technology collaborated in the selection and design of three technical assistance projects over the course of nine months. MMP identified private consulting firms to conduct the projects, each of which has contributed to the improvement of some aspect of Extrusion Technology's overall performance and competitiveness. This case study describes the development, implementation, and results of these projects, with special attention paid to the reduction in set-up time and the market research survey, both of which stand out as exemplary.

Making the Connection: Project Development

Extrusion Technology's referral to MMP came through an ISO-9000 certification program called ISONet, with which the company was working. ISONet was administered by the Bay State Skills Corporation (of which MMP is also a program). Jerry Rubin, director of MMP's Greater Boston regional office, believes this referral is an example of the highly effective network of manufacturing services emerging in Massachusetts. Mr. Sharpe's call to MMP was directed to MMP project manager, David Geschwind, who arranged for the two to meet.

Mr. Sharpe had a positive experience with ISONet, believing his company distinguished itself among its competitors by achieving ISO certification. Still, he maintained some skepticism going into his initial meeting with MMP. The image of a bureaucrat reciting "I'm from the government and I'm here to help" was one which he could not help but recall. Contrary to this image, he found MMP project manager David Geschwind to be capable and committed to helping small manufacturers understand their needs and realize greater

opportunities. Mr. Geschwind and MMP appeared well equipped to identify and manage private consultant expertise, and to turn ideas into productive action.

Following their initial meeting, Mr. Geschwind and Mr. Sharpe developed a list of improvement opportunities for Extrusion Technology. They prioritized this list on the basis of the company's needs and MMP's ability to help. Ultimately, they agreed to focus their work on three diverse initiatives that would require training, engineering, and marketing expertise. These initiatives integrated both men's top priorities, which were not always the same. For instance, Mr. Geschwind's insight and engineering background catalyzed an engineering project to increase productivity in the computer numeric controlled (CNC) machining department. The other two projects would seek to improve cross-department supervisor communication and production scheduling through training, and solicit feedback from customers through a market survey.

MMP, through its ability to leverage diverse resources on behalf of small manufacturers, was able to address Extrusion Technology's diverse improvement needs. This flexibility, which is a function of MMP's service delivery model, enables the partnership to develop trusting, long-term customer relationships. When appropriate, MMP can meet a company's already identified improvement priorities, in addition to critical improvement concerns that project managers diagnose. Mr. Geschwind believes, "It is very important that we have the flexibility to engage a company in an ongoing relationship. We can't just go in and say 'we know what's best for your business.' We have to establish some credibility with them first." Satisfied they were on the right track, Mr. Geschwind and Mr. Sharpe agreed to proceed.

Initial Project Focus: Supervisor Training

The Problem and the Assistance. Mr. Sharpe had identified a pressing need for improved communication among his top supervisors. Lack of intra-departmental information sharing was creating inefficiencies in production and delivery performance. The supervisor training project focused on improving supervisory skills and enhancing awareness and use of scheduling boards to facilitate production. These training needs had not previously been addressed because Extrusion Technology has no internal human resources department or specialist. The Employee Association, Inc. (TEA), a private, non-profit human resource and training services company, was found to have the specific training expertise that the project would require.

TEA designed a program to provide supervisors with a better understanding of the communication demands of production and delivery scheduling. The program also helped introduce a new supervisor into the organization. The emphasis throughout the project was clearly placed on developing a team philosophy among Extrusion Technology's supervisors, and linking the attainment of organizational goals to the improvement of cooperation and coordination among departments.

The Outcome. One year after completion of this project, Mr. Sharpe reflected on its success: "The project resulted in immediately improved communication, which has directly impacted our ability to work as a team." He noted that through improved use of scheduling boards and more effective supervisor communications, Extrusion Technology has "virtually eliminated last-minute production expediting." The resulting improvement in business performance includes a dramatic reduction in the late shipping rate by his company—from 17 percent to 5 percent. According to Mr. Sharpe, no other factors have contributed to this change. Along with the benefit to customer relationships, Mr. Sharpe calculates direct savings attributable to this project at $10,000 a year. The project also served as a successful introduction of MMP services to Extrusion Technology and revealed to the company's supervisors and key management the benefits of taking time out of busy schedules to make fundamental improvements in their operations.

Set-Up Time Reduction

The Problem. The extrusion of aluminum, an initial step in Extrusion Technology's manufacturing process, is a fast operation compared to the subsequent steps required to produce finished components. Therefore, the output of the CNC machining department, which performs a number of these finishing processes, controls the output of the entire operation. This department had a longstanding backlog of work and was regularly forced to send machine work to outside vendors to meet production schedules. Mr. Sharpe, who recognizes machining as his company's primary value-added activity, referred to Extrusion Technology as "a machine shop with an aluminum extruder." Mr. Geschwind realized that improving this department's operations was critical to the company's immediate and long-term competitiveness.

One element of the company's preparation for the MMP projects was the completion of a performance benchmarking questionnaire, a manufacturing assessment tool developed by the Performance Benchmarking Service™. The questionnaire measures business performance, using a number of indicators, including set-up times. The resulting report quantified company set-up times and confirmed that the CNC machining department was a critical area for improvement. Mr. Geschwind then initiated an extensive search for a suitable consultant to further assess and resolve the problems confronting this department.

The Assistance. His search led to Ned Emerson of Value-Tech Engineering, Inc., an expert in machining, CNC programming, and tooling and fixturing. In Mr. Sharpe's words, "Even if we knew we needed him, we never could have identified Ned on our own. We wouldn't have known where to start." Mr. Geschwind commented, "He was the only one in the area who had the right combination of skills for the job." The three men collaborated in developing a scope of work for the project.

Mr. Emerson began work by conducting a comprehensive assessment of the department. He confirmed suspicions that poor machine utilization and overly extended machining cycle times were a major part of the problem. He identified a need

for fixtures designed to allow higher run speeds and feed rates, and to reduce or eliminate tool changes that were extending machining cycle times. Mr. Emerson also believed that purchasing and implementing a CAD/CAM software package would yield a substantial return on investment. This software would correct another inefficiency—the need to generate numerically controlled machine programs line by line. Having identified these problems and potential solutions, the team then defined the project's scope.

Over ten sessions, Mr. Emerson worked closely with Paul Redmond, CNC machining department supervisor, to determine the most cost-effective CAD/CAM system for the department. On his recommendation, a $6,000 Licom system was purchased and installed. Mr. Emerson then trained staff to use it. The Licom system made an immediate difference, eliminating the need to write line-by-line machine instructions, thereby reducing set-up times for all components (see *Investment and Results*, below). Mr. Emerson then began the improvement of set-up operations for five specific components for which Extrusion Technology receives regular orders. Innovative fixture design and the development of specific procedures to guide the design and use of quick-change tooling plates significantly reduced machining cycle times. The improved fixtures, coupled with the CAD/CAM system, enabled the department to significantly increase feed rates and run speeds on the CNC machines. The ability to push more jobs through at faster rates resulted in increased productivity.

The Outcome. Ten months later, the results of this project are impressive (see Table 1).

Table 1

Project Outcomes: Set-up Time Reduction*

Set-Up Time Reduction	Sustainable savings	$10,000/yr.
Production Increase	Sustainable improvement	$20,000/yr
Leveraged Capital	Licom CAD/CAM	$ 6,000
Investment equipment rotary table, pallet changer, cutting tools, holding fixture	CNC shop	50,000

**Figures do not include staff time calculations*

Extrusion Technology experienced a productivity increase in the CNC Machining Department of between 100 percent and 200 percent, depending on the component being run at the time of measurement. The company has also reduced set-up times on the five target components by 50 percent and across the department as a whole by 40 percent. These performance improvements have led to bottom line, sustainable savings of $10,000 a year from set-up reductions and $20,000 a year in increased productivity from increased feed rates and run speeds.

In addition to these savings, the department now sends much less work out to other machine shops. While the company is not able to calculate the savings from this change, the figure is believed to be substantial. The diverse nature of the jobs run by Extrusion Technology has confounded an exact calculation of the resultant savings; because products and run volumes vary widely, it is nearly impossible to create a benchmark for comparison over time. The company will also reap additional savings because the machining department has increased capacity and confidence to design and build its own tooling fixtures, allowing for increased productivity and efficiency for future product runs.

Regarding the CAD/CAM system, Mr. Sharpe remarked, "Ned gave us the confidence to invest in a $6,000 CAM system that we can't believe we didn't have before." Paul Redmond agreed, "It was something we knew we needed, but we needed a push to get there." The confidence that Extrusion Technology gained through this purchase and successful implementation may be the project's single greatest long-term impact. According to Mr. Sharpe, the momentum created by this modernization project has resulted in an additional investment of over $50,000 in new equipment which otherwise would not have occurred in the foreseeable future. The project produced substantial productivity improvements, leveraged further investment, and gave the company a competitive advantage.

Market Research Survey

The Problem and the Assistance. Encouraged by the project's success in reducing set-up time, Mr. Sharpe and Mr. Geschwind focused on the third priority they had identified—a marketing research study. After careful consideration, they contracted Diagnostics Plus, a private consultant, to conduct the market survey. The intention was to solicit feedback from Extrusion Technology's past and present customers regarding, among other things, their perceptions of the company's quality, performance, price, and delivery, and to generate new product suggestions.

The survey's importance should not be understated. Because Extrusion Technology's sales are driven exclusively by catalog advertising, the company has a small sales team, which lacks the expertise needed to design and implement a sophisticated marketing survey. Diagnostics Plus has that capability and, in consultation with Mr. Sharpe, designed a survey sensitive to Extrusion Technology's operations and customers. Diagnostics Plus conducted the survey by phone and synthesized results from 95 respondent customers in a comprehensive report to the company.

The Outcome. Mr. Sharpe was quick to point out that "some real surprises" emerged from the responses received. "Customer feedback regarding [Extrusion Technology's] performance in pricing, quality, and delivery has already triggered changes in the company's business practices." But the greatest value of the study, according to Mr. Sharpe, relates to the new product development opportunities it presented his company. "Before I had this study, I would have told you from speaking with our customers that they didn't need anything else from us." But customers had a number of new product suggestions that are already beginning to generate business for the company.

Six months after the study was completed, Mr. Sharpe reached agreement with a customer to manufacture a new product, which he expects will generate $200,000 in annual sales. He intends to hire six new employees to meet the new production demand (see Table 2), and is confident that other opportunities will flow from the survey in the future.

Table 2

Project Outcomes: Market Research Survey*

New Product Development	Increased sales this year	$200,000
Additional Jobs	Will result this year	6

Investment and Results: Understanding the Impact of Massachusetts Manufacturing Partnership Services

Extrusion Technology faces challenges common to many small manufacturers in Massachusetts: a talented, dedicated staff who must strive daily to surmount the tremendous obstacles presented by the varied demands of production in a highly competitive global marketplace. Their processes often rely on aging equipment; they cannot afford to retain engineering and marketing specialists on staff; and they work in the leanest possible environment, with enormous demands placed on managers' time.

MMP benefited Extrusion Technology and its current and future employees by offering solutions to these problems—solutions which yielded significant, tangible results (see summary in Table 3). Its outside perspective, carefully trained on the big picture, helps managers who are sometimes too busy "putting out fires" to deal with the underlying issues that affect their productivity. "MMP leveraged confidence and created momentum for change and modernization among our managers and employees," commented Mr. Sharpe. As Paul Redmond confided, "Our CNC machining department was operating in the late 1970's; now we're in the early 1990's." Managers knew there was technology available to improve their productivity, but lacked the resources to pursue it. MMP provided those resources.

Ultimately, it's all about making manufacturing work. Small manufacturers can succeed, but they often need a "little push." Such was the case at

Extrusion Technology, where sales growth exceeded 18 percent the last 2 years and is expected to improve at a greater pace in the near future. "There is no question, we would not have undertaken these projects without the assistance of MMP," Mr. Sharpe reflected. The implications of this statement are clear. Without MMP, Extrusion Technology would not have made these investments to improve its internal communications and productivity, nor have identified new product development opportunities. In short, the company would not have moved forward on the road to increased competitiveness.

Table 3

Project Outcomes Summary

Benefit to Extrusion Technology	
Production cost savings	$ 30,000/yr.
New sales	$200,000/yr.
Benefit to U.S. Economy	
Additonal business to domestic vendors (capital investments)	$ 56,000/yr.
Additional jobs created	6

**Figures do not include staff time calculations*

CHRONOLOGY OF SERVICES

October 1994	• Extrusion Technology President, Jim Sharpe, initiates contact with GBMMP, following referral by staff of ISONet. MMP project manager David Geschwind participated in a plant tour, made an initial assessment of Extrusion Technology, and initiated discussion of possible projects to improve business competitiveness.
November 1994	• Identified need for communications training program for supervisors. Identified TEA Associates as a resource to conduct project. • Conducted performance benchmarking assessment and analyzed resulting benchmarking report.
December 1994	• Carried out supervisor training project. Also, identified critical productivity issues in CNC machining department and located ValueTech Engineering as a resource for addressing problem.
January 1995	• ValueTech conducted a comprehensive analysis of the CNC machining department. Identified specific products for tooling re-design and documented set-up time reduction methods. Installed Licom CAD/CAM software and provided appropriate training.
February 1995	• Completed final phases of set-up time reduction project and submitted final project report.
March-April 1995	• Began development of project to improve customer satisfaction and marketing. Selected Diagnostics Plus as resource to conduct project.
May-June 1995	• Mailed satisfaction/marketing questionnaires to customers.
July 1995	• Received and analyzed survey responses.
August 1995	• Completed final report and made recommendations. Initiated new product development talks with respondents.

Case Study

GALILEO CORPORATION

Sturbridge, Massachusetts

MASSACHUSETTS MANUFACTURING

PARTNERSHIP

AT THE BAY STATE SKILLS CORPORATION

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Galileo Corporation

Galileo Corporation develops, manufactures, and markets glass fiber and electro-optic components, assemblies, and systems. Galileo, located in Sturbridge, Massachusetts, employs 200 people and operates four diverse business divisions in one manufacturing location. According to Galileo's president, William Hanley, the company is a defense conversion success story, having made a 95 percent conversion from defense to commercial markets over the last 10 years. After a difficult period of adjustment, Galileo has returned to profitability, posting a 13 percent growth in sales in 1995. Over 20 percent of its $34 million in sales in 1995 were to foreign markets.

Founded in 1959, Galileo was one of the first independent manufacturers of fiber optics. The company's four business divisions include office products, scientific detector products, medical products, and remote sensing products. With the assistance of Massachusetts Manufacturing Partnership (MMP), Galileo has made great strides in further increasing its profitability and market potential. At no loss for words regarding Galileo's experience with MMP, Mr. Hanley refers to the program as "the best idea the U.S. Commerce Department has ever had." Assisted by Paul Cotnoir, director of MMP's Central Massachusetts affiliate office, Galileo has experienced increased productivity and sales, while competing against world-class competition from Europe and Asia.

Making the Connection: Project Development

Mr. Hanley became aware of MMP in its early formation, through contacts at Worcester Polytechnical Institute (WPI). He was excited by the prospect of a resource that would bring an outside perspective and engineering and other expertise to small manufacturers in Central Massachusetts. He contacted the local MMP affiliate office immediately after it opened. This call led to an initial meeting between Messrs. Cotnoir and Hanley and other key Galileo staff in July 1994.

A series of meetings followed this initial contact, including a plant tour, a comprehensive business assessment, and a focus group with Galileo management. The end product of these meetings was a prioritized list of opportunities for productive collaboration between MMP and Galileo. The highest priority was given to projects that would result in the most immediate and dramatic results at the lowest cost. The best opportunities for this type of quick success were in Galileo's most profitable divisions: office products and scientific detector products.

Project Focus: Automated Inspection of Micro-Channel Plates

The Problem. The scientific detector products division faced a challenge that, if met successfully, would result in enormous gains to the company,

which was pursuing a contract with a Netherlands-based producer of robotic eyes. Historically, Galileo had supplied image-intensification components for use in military night vision equipment, technology similar to that used in robotic eyes. The problem was Galileo's inability to meet the inspection and quality standards on which the contract depended. After defining possible solutions in meetings with Mr. Hanley and senior engineer Tom Barth, Mr. Cotnoir was confident that he could find a consulting resource to meet this challenge.

The Assistance. Mr. Cotnoir's search process led him to William Johnson of BOA Consulting in Worcester. Mr. Johnson, a WPI graduate student in manufacturing engineering, had the specific computer programming skills and background that the project required. Following Galileo's approval, he was contracted to write an image processing software program. This program would enable the quantification of quality test parameters by a vision inspection system already in place at Galileo. The software would be compatible with existing hardware and have the capacity to generate inspection reports for customers. Over the course of four weeks, Mr. Johnson developed the program and designed a user interface.

The Outcome. Mr. Hanley viewed the project as a complete success for Galileo, referring to it as "the bargain of the century." The cost of developing this new inspection capacity was $3,250. The benefit was a $625,000-a-year contract to manufacture image-intensifying micro-channel plates, which Galileo wrested from a Japanese competitor. MCP production has already started. Mr. Hanley views MMP as the critical agent in his company's development of an inspection capability sufficient to meet the requirements of this new contract. MMP was instrumental both in identifying the need and in matching the appropriate consulting resource to the problem.

Project Focus: Workflow Enhancement

The Problem. MMP identified another opportunity for a quick-return, high-impact project in the office products division. Initial assessments had indicated substantial opportunities for improvement of workflow and productivity on the corotron bare wire assembly (CBWA) line. The CBWA line assembled components for high-speed copiers for Xerox. Mr. Cotnoir asked Automation and Information Planners (AIP), of Worcester, to present its throughput improvement process (TIP) to Galileo. Mr. Cotnoir believed TIP, which was developed by AIP owner and president, Michael Charchaflian, to be well-suited to the problem. Galileo approved of AIP's approach and qualifications and contracted the company to perform a workflow enhancement project for the CBWA line.

The Assistance. The TIP process began with a rigorous and comprehensive assessment of workflow within the CBWA manufacturing process. AIP's assessment consisted of time study analyses and workflow reviews, followed by computer simulation of numerous workflow modification scenarios.

The Outcome. This approach allowed the planners to generate detailed recommendations for improvements in workflow and provide Galileo with a clear perspective on the CBWA line's potential performance and profitability.

However, after reading the final TIP report, Mr. Hanley and senior quality engineer Rich Emmons realized they had a decision to make. While Galileo could implement a number of productivity improvement suggestions within the CBWA line, they were not confident that the line would ever achieve profitability sufficient to warrant the investment. Their final decision was to terminate this ongoing contract, and divert the company's resources to the more profitable di-corotron line within the same division.

The value of the decision to close the CBWA line is difficult to quantify, but its implications are not hard to grasp. Galileo received and acted upon the wealth of objective data provided in the TIP report. For the first time, it was able to review this line's profitability potential with comprehensive information to back up assumptions. As a result, the company will now focus its resources on higher-return investments, improving its overall competitiveness. The information generated during the workflow analysis was the basis for this informed decision making. Mr. Hanley, pleased with the rationality of the process, has furthered his commitment to rational decision making by hiring an industrial engineer to implement other AIP suggestions.

Project Focus: Vendor Analysis

The Problem. Significantly, another improvement opportunity was identified during the TIP assessment project to enhance workflow. Some of the vendors on whom Galileo depended to manufacture plastic parts and perform finishing processes, such as painting, were located at great distances from its plant. This circumstance was due, in part, to the fact that Galileo had closed another plant in early 1994, consolidating operations in Sturbridge. Existing vendor arrangements remained in place, however, and, until this time, no one had studied these vendors' performance.

Prompting this study was the realization that Galileo was paying high shipping charges and that managers had less awareness of vendor operations, efficiency, and quality than they would have liked. MMP contracted AIP to conduct an analysis of these vendors for the CBWA line and for another office products line that refurbishes di-corotron wire housings. This analysis was an addendum to the workflow enhancement project and ran concurrent with it.

The Assistance. The vendor analysis began with developing a procedure to examine vendor price, quality, and processes. Subsequently, AIP made arrangements to visit vendor plant facilities to examine their operations. Finally, it conducted a search to identify alternative vendors. Some special effort was made to identify potential vendors in the Sturbridge area to minimize shipping charges, production delays, and other problems that might be alleviated through face-to-face communications. AIP then documented this customized vendor selection process for application throughout the company.

The Outcome. The vendor analysis produced immediate benefits for the company. While discontinuing the CBWA line meant that no cost savings were realized there, costs fell dramatically after the company implemented the planned

vendor changes on the di-corotron product line. Galileo's vendor source changes on this line have resulted in higher-quality parts at lower costs, massive reductions in shipping costs, vastly improved response and delivery performance, and certified parts mandates. The company now is near enough to its vendors to hold routine meetings and more effectively manage vendor relations.

What this result means to the bottom line is $500,000 per year in documented savings through cost reduction, which may well reach $1 million in a few years (see Table 1). Mr. Hanley fully expects the new vendor selection process to be implemented across the company. As Mr. Emmons noted, "We were always too busy firefighting to look into changing vendors. Now we use more competitive local suppliers who have added 20 to 30 jobs to our local economy." Galileo has also invested in improving the processes of these suppliers, purchasing a $200,000 painting system for use on its orders by one company.

Investment and Results: Understanding the Benefit of Massachusetts Manufacturing Partnership Services

MMP's overall impact on Galileo's competitiveness and business performance is clear (see Table 1, Project Costs and Outcomes). But, as Mr. Hanley noted, what is important to understand is that MMP addresses two fundamental areas of concern for small manufacturers that private consultants cannot. First, it brings in an outside perspective to assess needs within the company. This step is important because, unlike consultants, MMP has no profit motive when it approaches companies, and is well-positioned to develop trusting relationships and provide companies with new insight into their businesses. The second concern falls out of a common lack of internal resources, which forces small manufacturers either to look for outside expertise or to "muddle through" with things as they are. According to Mr. Hanley, even when problems are identified, "The process of resource selection is so laborious that we often just don't bother. And you're scared you'll get your pocket picked, too. This has happened to us." MMP addresses this concern by locating capable consultants through an established network of resources and by managing project contracts to ensure that work is completed to the customer's satisfaction. This approach minimizes the risk and timelines associated with outside consultant selection.

It is MMP's ability to address these fundamental concerns that makes it a necessary and effective catalyst for modernization and adoption of best manufacturing practices among small manufacturers. "They helped us see the forest for the trees," commented Mr. Emmons. "We not only gained a new perspective, we developed projects to improve. And now, with the success we've had, improvement and change have become part of our culture."

Table 1

Project Costs and Outcomes

Table A

Project Costs

Automated inspection of micro-channel plates	$3,250
Workflow enhancement	$15,000
Vendor analysis	$5,000
Total Costs	**$23,250**

Table B

Project Outcomes: Automated Inspection of MCPS

New micro-channel plates contract	sustainable	$625,000/yr.

Table C

Project Outcomes: Workflow Enhancement

Workflow improvement	Hired one industrial engineer	One professional FTE

Table D

Project Outcomes:
Vendor Analysis

Vendor analysis	cost reduction	sustainable, may grow	$500,000/yr.
Vendor analysis	capital investment	new painting equipment	$200,000/yr.
Vendor analysis	new jobs	resulting hires by new vendors	20 FTE

Table E

Project Outcomes:

Summary

Total direct benefit to Galileo Electro-Optics	$1,125,000/yr.
Increased taxable sales (export)	$625,000/yr.
Additional business to domestic vendors	$200,000/yr.
New jobs created	21

CHRONOLOGY OF SERVICES

1994

July	• Received inquiry from William Hanley, president of Galileo, regarding MMP services. Arranged initial visit to plant.
August	• Paul Cotnoir conducted plant tour and key staff interviews, which helped identify possible projects to improve competitiveness.
September	• Received AIP proposal for workflow improvement project on the corotron bare wire assembly (CBWA) line. • Received proposal from BOA Consulting for automated inspection of micro-channel plates (MCPs).
October	• Signed contract and began work on workflow improvement project. Focused on current performance documentation on CBWA line. • Signed contract and began work on MCP inspection project. Focused on user documentation and image manipulation.
November	• Conducted sub-process analysis of CBWA line, analyzed possible productivity/profitability improvement scenarios through computer model simulations. Recommended and accepted plastics vendor analysis project. • Completed MCP inspection project, including image manipulation capacity and user interface development. Delivered final report.
December	• Completed CBWA WIP project and submitted final report. • Conducted plastics vendor analysis. Produced and implemented new vendor selection methodology on corotron and di-corotron bare wire assembly lines.

1995

December	• Reported a 13 percent growth in sales. • Reported over 20 percent of $34 million in sales were to foreign markets.

Case Study

GLENDALE TECHNOLOGIES CORPORATION

Lisle, Illinois

CHICAGO MANUFACTURING CENTER

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

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CASE STUDY

Glendale Technologies Corporation

Glendale Technologies Corporation (GTC), was founded in 1990 by Mr. Lee Lu and a group of investors to assemble and sell lowcost computer systems primarily for largevolume purchasers or for resale in computer stores.

Currently, GTC has a total of 21 full-time employees, four of whom it currently contracts out to work with other companies on an hourly fee basis. GTC also has four part-time workers. LS International (LSI), the retail side of the business, has three salespeople. Both operations are housed in a new 10,000-square-foot facility in Lisle, Illinois, some 20 miles west of Chicago. Sales figures for 1995 stood at $5.25 million. 1996 sales are estimated at $7 million.

GTC is in a fiercely competitive business, with thousands of competitors ranging from the giant companies like Compaq, Packard Bell, and IBM, to one- or two-person operations selling strictly on price. However, by carefully monitoring its purchases and getting the lowest available prices on parts, GTC is in a fairly strong competitive position. Using Taiwanese supply sources established before GTC went into business, the company was able to enter the market and become an immediately effective competitor.

Rapid Expansion Threatens Company's Viability

In February 1995, a Chicago Manufacturing Center (CMC) marketing affiliate visited GTC and met with Mr. Lu. Mr. Lu expressed a strong interest in having CMC conduct a full assessment of GTC, because his business was experiencing serious difficulties. In fact, between the initial contact and the assessment visit, Mr. Lu was forced to reduce his staff to 12 full-time and four part-time employees. Most of these difficulties stemmed from GTC's expansion rate: its unit costs began to shoot up and reduce the corresponding profit margin. To get costs back under control, Mr. Lu had already begun the process of temporarily reducing the scale of his operation.

Targeted Assistance Areas

CMC spent less than 50 hours with Mr. Lu and his staff, averaging four hours per month. On April 13, a CMC team headed by George Beattie, a senior program manager, spent a day in the facility conducting a rigorous assessment of GTC operations. The team identified three specific areas for GTC to address to achieve its goal of increasing sales without reducing profit margin.

Personnel Management. First, GTC's sales department was suffering from a very high personnel turnover rate. CMC recommended assessing the management and supervisory skills of

GTC's sales manager and developing a team-building system to improve communications and interpersonal relationships within GTC's sales department. The project proposal was delivered to GTC in June 1995, and was a key factor in causing the sales manager to resign a few weeks later. Personnel problems thereafter were significantly reduced.

Shortly afterwards, Albert Wey joined the organization as a partner, and assumed the role of general manager—a personnel change accelerated by the sales manager's resignation. This allowed Mr. Lu more time to focus on marketing and sales, his areas of expertise. Formerly, Mr. Lu had to handle all types of problems that arose in assembly, sales, marketing, personnel, or other areas. By hiring a general manager, Mr. Lu was able to concentrate on GTC's sales growth instead of being pulled in all directions for crisis control.

Minority Supplier Certification Status. Second, CMC recommended that GTC boost its sales potential by reapplying for minority supplier certification status with various governmental agencies. GTC had previously applied for certification, but let the certification expire, and had not taken advantage of its potential for generating additional sales. CMC assisted GTC in completing and filing this application with several local government agencies.

SBA 8(a) Certification. CMC further recommended that GTC apply for and obtain certification as a Small Business Administration (SBA) Section 8(a) contractor to permit negotiation as a sole source supplier for federal procurement. This move was viewed as another way to generate sales and expand GTC's customer base. Again, CMC assisted GTC in completing this application, which was filed in late 1995 and is still pending.

Sharing of Production Schedule Information. The CMC team made several additional operations-related observations, including the level of disruption in production caused by sales staff trying to discover the status of particular orders. Although GTC had a software package in the facility to facilitate its accounting process, it did not have the capacity to help with inventory control or perform job tracking and costing because the package did not have real-time capabilities. CMC recommended introducing new automated scheduling software.

Mr. Wey did not follow this exact prescription, but did introduce a manual scheduling system, which fills the same need. He installed a bulletin board to display the production schedule information this system generated, and located it between the production and sales areas. Thus, when salespeople need specific order information, they can get it from the board rather than interrupt the assembly process. As a consequence, the assembly workers no longer have a lot of time taken up dealing with specific inquiries, but, instead, can concentrate on assembly and not feel they have to rush and make up for lost time.

Formalization of Policies. Responding to another CMC recommendation, Mr. Wey also began formalizing operations and personnel policies by typing up brief memos on various topics and circulating them throughout the facility.

Market Development. The CMC team further observed that GTC was not actively working to diversify and expand its sales base. The company's main marketing technique was broadcast by fax,

primarily to existing customers. Mr. Beattie began to work with Mr. Lu and Mr. Wey on this and other marketing-related issues. He introduced GTC to CMC's "Finding Your Next Customer" program. Through group training sessions and on-site consultation, CMC experts guide management through the process of developing and implementing a marketing and sales plan. This customized approach combines the company's unique knowledge and experience with the expertise of marketing professionals to construct a comprehensive and effective sales initiative. GTC used this program to develop marketing materials for its booth at the national COMDEX trade show in June 1996. At the same time, the company is working on a business plan, which it hopes will result in $100 million in sales within 5 years. This plan includes expansion into the customized computer and service areas, primarily through franchises.

Under this "Finding Your Next Customer" program, GTC has so far participated in group training sessions and received 80 hours of on-site marketing-related assistance.

Outcomes

Since CMC began working with GTC, the company's financial position has improved significantly through increased sales, reduced scrap and reject rates, and a substantial increase in the firm's "gross margin," (i.e., the difference between the value of sales and costs).

First, within a few months of filing the application for minority supplier status, GTC obtained a local government contract worth $500,000 that it would not have received otherwise.

Second, adopting CMC's recommendations to provide easier access to production scheduling information and to formalize operations and personnel policies directly contributed to markedly reduced scrap and rework rates (see Table 1).

Table 1

Glendale Technologies Corporation: Quality Assurance

	1993	1995
Scrap Rate	3.2%	2.4%
Reject Rate	2.0%	1.5%

The firm's increased sales and reduced costs have combined to help GTC nearly double its gross margin in a single year— from 9.6 percent of sales in 1995 to 17.6 percent during 1996. Obviously, this is a very significant improvement in GTC's overall financial performance (see Table 2).

Third, from a marketing perspective, Mr. Lu now devotes most of his time to sales development. This shift was facilitated in part by CMC's proposal to assess the Sales Manager position, which, as noted, both caused the existing sales manager to resign and accelerated hiring of a new partner/general manager. Since then, Mr. Lu's time has freed up, which allowed him, with direct CMC program

Table 2

Glendale Technologies Corporation: Financial

	1992	1993	1994	1995	1996
Sales	$4.72	$8.94	$5.90	$5.25	$7.00
Cost of Goods	$4.31	$8.02	$5.22	$4.70	$5.77
Gross Margin	$0.41	$0.92	$0.68	$0.55	$1.23

support, to develop material for the COMDEX show. This event generated 3000 business leads of which Mr Lu is targeting the 1000 most promising for near-term followup. He also is drafting an ambitious, but systematically developed, business marketing plan.

As an offshoot of that planning activity, and with the encouragement of CMC, Mr. Lu is using CMC's international network to help him pursue overseas expansion. For example, GTC recently met with trade representatives from Poland and Finland, and the company subsequently entered into a contract with the Finnish representatives to explore business opportunities there.

These factors, in addition to GTC taking a more active cash management role, have stabilized the company's financial position and put it in a place where it is poised for growth. CMC also continues to advise the company and to link it up with other CMC clients and/or services.

Public Benefits

Full-time employment in the company has increased from 12 at the time of the CMC assessment (April, 1995) to 21 in April 1996.

External Factors

Several external factors have contributed to the success of the GTC/CMC relationship. Mr. Wey joining the organization has facilitated the implementation of several CMC recommendations. Also, the phenomenal growth in the computer industry both nationally and internationally cannot be ignored. However, due to the fiercely competitive nature of the computer industry, GTC would not be in a position to meet this increasing demand if they were financially unstable and produced products with high reject rates. In addition, because the industry is dominated by major brands, marketing is extremely important. CMC has assisted GTC to improve in all of these areas. While it is not possible to know if GTC would eventually have identified these issues and started working to resolve them, Mr. Wey himself acknowledges it was hard to "see the forest for the trees" because the firm was relatively small and operated in a reactive rather than proactive mode. CMC played an essential role in providing a broader perspective.

A Valuable Partnership

Both Mr. Lu and Mr. Wey view their relationship with CMC as a partnership, where all parties speak the same language. CMC's extensive experience in the electronics industry has guided GTC "in the right direction" and helped shorten its growth time frame. When talking about CMC, Mr. Wey best describes how the relationship works in saying that it has helped him translate theory into more practical, real-world applications.

CHRONOLOGY OF SERVICES

1990	• Company founded.
1993	• Sales grow by 90 percent, with inventory being financed through borrowing - Employment at GTC peaked at 32 employees.
1994	• Decision to reduce sales volume to assist financial health of company. - GTC employment fell to 20.
February 1995	• Herb Russcol contacts Lee Lu to set up an initial visit. - Glendale Technologies move to new 10,000 square foot facility.
March 1995	• Initial visit of Glendale Technologies conducted by Herb Russcol who presents CMC services to Lee Lu. - Employment at GTC continues to fall, reaching an historic low of 12 full-time and 4 temporary employees.
April 1995	• CMC team, led by George Beattie, conducts an assessment
May 1995	• CMC staff deliver assessment report to Lee Lu, identifying three particular action items.
June 1995	• ITA on company restructuring. - ITA for sales development. - CMC delivers a proposal to conduct an assessment of the sales manager position.
July 1995	• Sales Manager resigns before project accepted.
October 1995	• Retail operation relocated to GTC facility. - Albert Wey joins GTC as Vice President of Production. This frees up Lee Lu, who is then able to devote most of his time to sales development. - SBA Section 8(a) Sole Source Contractor Certification application completed with assistance from CMC staff. - With assistance from CMC, GTC reapplies for minority supplier certification with many units of local government.
November 1995	• Albert Wey begins to introduce formal operational procedures for GTC. - GTC begins to receive minority certification.
December 1995	• GTC signs up for CMC's "Finding Your Next Customer" program.
February 1996	• "Finding Your Next Customer" program begins.
April 1996	• Employment at GTC stands at 21 full-time and 4 temporary employees.
June 1996	• With assistance, GTC has a substantial booth at COMDEX trade show in Chicago.

Case Study

HAAS-JORDAN CO., INC.

Lake Erie, Ohio

LAKE ERIE MANUFACTURING EXTENSION PARTNERSHIP

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Richard L. Hanson

Lake Erie Manufacturing Extension Partnership

Toledo, Ohio

CASE STUDY

Haas-Jordan Co., Inc.

Haas-Jordan Co., one of only seven surviving umbrella companies in the United States (out of about 200 at the turn of the century), is run by David Waltz. Thomas Waltz, his brother, runs the F.J. Westcott (Westcott) Company. Both companies are located in the same building in Toledo, Ohio. Westcott does all the silk screening for Haas-Jordan and markets light control products to professional image makers, along with a number of other products directed at that market.

Haas-Jordan was created in 1899 as the Hull Brothers Umbrella Manufacturing Company. When the Company relocated to Toledo in 1903, it became the Hull Brothers and Haas Umbrella Manufacturing Company. The Haas at that time was Cloyd Haas, grandfather of the Waltz brothers. In 1933, the company became Haas-Jordan Company and introduced the golf umbrella to America. In 1959, it was the first to silk screen club crests on golf umbrellas. Today, 97 years after its founding, Haas-Jordan is the leading supplier of quality imprinted umbrellas and related products to golf clubs, resorts, major PGA tournaments, golf manufacturers, and corporations.

Haas-Jordan products are crafted with pride by American workers in Toledo, Ohio, or built to demanding Haas-Jordan standards in the company's overseas factories. HaasJordan has high quality standards for materials and workmanship, which allow it to offer a one-year limited warranty against defects in materials and workmanship. For example:

- All Haas-Jordan products are inspected, both during manufacture and immediately prior to shipment.
- Haas-Jordan's custom-made nylon cover fabric is 28 percent more densely woven than the fabric used by competitive brands, ensuring better water repellency and higher imprint quality.
- A total of 225 custom colors is available.
- To ensure superior resistance to the damaging effects of wind gust, the frame wire is 18 percent wider than that in competitors' frames. The unichrome frames are made of corrosion-resistant, high-strength, zinc carbon steel. The fiberglass shafts have an extra thick wall.
- High-impact, molded plastic components enhance product value and durability.
- All handles are permanently attached with epoxy adhesives or carefully countersunk stainless steel nails.

Haas-Jordan is clearly a company concerned about quality.

Technical Assistance Provided

Both David and Tom Waltz have come to trust the economical, cost-effective assistance provided by the Lake Erie Manufacturing Extension Partnership (LEMEP), a division of the Edison Industrial Systems Center (EISC). EISC is one of seven State of Ohio supported Thomas Edison Centers. Haas Jordan and Westcott are located in the heart of the LEMEP service region.

In December 1994, Jim Matzinger, field engineer of LEMEP, contacted David Waltz, president of Haas-Jordan, to present LEMEP capabilities and to get a feel for the business and Mr. Waltz's vision of Haas-Jordan's future.

Wind Velocity Testing. For more than 6 years, David Waltz had been looking for a reasonably priced facility to conduct structural testing on a variety of umbrellas the company produces. Mr. Matzinger went to work on the problem, and, in February 1995, presented a proposal to test samples at the University of Toledo Department of Mechanical Engineering.

Approximately 20-30 umbrellas could be tested daily for wind velocity and wind incident angle while being videotaped and observed by Haas-Jordan personnel. This type of product testing had never before been conducted in the facility. However, with minor modifications to the tunnel, Haas-Jordan was able to conduct critical wind-velocity testing on several dozen umbrellas over a two-day period. The testing represented a savings of $15,000—$18,000 for Haas-Jordan, a direct result of LEMEP providing access to the University of Toledo facility at a rate much lower than the cost of renting NASA's wind tunnel in Cleveland, Ohio, at $10,000 a day. In addition, several months of waiting for an available wind tunnel facility were eliminated. Haas-Jordan gained valuable information to help develop new product growth opportunities and thus enhance its market share. It considered the project to be a complete success.

Specially Designed Hoop Assembly. Mr. Matzinger responded to another problem in March 1995. Development work performed by Westcott, which does all the silk screening for Haas-Jordan, had demonstrated the feasibility of using a specially designed hoop assembly to firmly press and hold fabric during silk-screening operation. Its successful implementation would allow the silk-screen design to pass over a seam. In the past, large designs were silk screened on each panel and then matched by the seamstress—a time-consuming operation prone to rework. Thus, most silk-screen designs were limited to the size of one of the umbrella's eight panels. Interestingly, in times past, umbrellas with significantly more than eight panels were a status symbol.

Mr. Matzinger used his manufacturing experience to bring the involved personnel together—from the vice president of manufacturing to the machine operator—for a brainstorming session. The meeting took place on the shop floor and proved to be highly productive in identifying what was needed to make the concept work.
Mr. Matzinger then tapped his tool and die resources to translate the concepts into machine modification and fixture sketches. Mr. Matzinger evaluated quotes received from two companies and awarded the project to the more cost-effective one.

The installation went smoothly and, after a short start-up, one operator was running the machine, producing quality products and generating cost savings from operations that were 25 percent more efficient. Having the ability to silk screen over a seam allowed Haas-Jordan to accommodate larger logos, and gave the combined companies a competitive advantage. They were able to significantly increase their volume in the custom logo market niche.

Adhesive Interface Development. In December 1995, Mr. Matzinger worked on an adhesive interface development project for Westcott. The problem was associated with finding an adhesive system for bonding aluminum tips to the four flexible steel rods used to support a reflective fabric canopy. The steel rods are approximately 3/16 inches in diameter, 3 feet long, and powder-coated to replicate aluminum. Aluminum tips are used at both ends of the rods to prevent wear and to provide a stop for a supporting ring that contains a light source. The joint between the steel rods and the aluminum tips is subject to shear loading conditions and elevated temperatures as high as 300^0 F for prolonged periods. The project objective was focused on finding an adhesive system and developing application procedures to satisfy all constraints.

When Tom Waltz funded the proposal Mr. Matzinger produced, Lake Erie MEP turned to another Thomas Edison Center—the Edison Welding Institute (EWI)— to solve the problem. EWI has world-class experience in joining all types of materials. EWI assistance helped to identify the appropriate adhesive and the proper application process to render another Westcott problem solved in a cost-effective manner.

QuickView Plus Benchmarking. In January 1996, Mr. Matzinger and Daniel Pullman, Haas-Jordan vice president of manufacturing, discussed the preparations Mr. Pullman was making for presentation of the annual plan. Mr. Matzinger recommended that he benchmark his business and, together, they completed a QuickView Plus Benchmarking funded through LEMEP. The resulting profile report benchmarked Haas-Jordan against established national and international standards and offered diagnostic guidance and recommendations useful in outlining a continuous improvement plan for the company.

At LEMEP, the field engineer has the responsibility to facilitate the QuickView evaluation and provide value-added input based on an analysis of the QuickView report and the knowledge gained in a detailed plant tour. Mr. Matzinger presented his findings in time to support Mr. Pullman's planning cycle. One key recommendation was to use an industrial engineer to set standards for new or changed operations, many of which stemmed from the management team's continuous improvement efforts. The workers affected by these changed operations receive an average wage until a standard is set.

Prototype Development of Umbrella Components. In a meeting on February 28, 1996, with Haas-Jordan's president, Mr. Matzinger learned of the company's wish to develop prototypes of a new, reinforced umbrella tip cup and sleeve molded in one piece. The current design requires two

moldings with subsequent assembly. It was felt that significant savings and improved performance could be realized with a one-piece design incorporating peripheral reinforcing ribs. David Waltz requested a proposal.

Following discussion with Dick Hanson, Lake Erie MEP operations manager, Mr. Matzinger visited a Toledo private industry resource developed by Lake Erie MEP as a prototype operation. David Waltz funded the project, now in phase one, where a limited number of components are in prototype design and production. Phase two will involve a decision to quote and fund the production tooling. Phase one has been expanded to devise a prototype of a plastic, simulated-wooden handle. This project reflects not only the owners' cost consciousness, but their commitment to quality, as the wooden handle tends to deteriorate with time.

Outcomes

All of the projects that David and Thomas Waltz have undertaken with LEMEP's Mr. Matzinger have had or will have a favorable impact on the growth of both companies.

The large umbrella portion of total sales has increased significantly through the implementation of these projects.

Company officials attributed about $250,000 of the total sales increase to LEMEP assistance.

Implementing the new business practices in the silk-screening operations helped facilitate this growth while improving productivity. One operator is now running the operation, which is 25 percent more efficient. If $25,000 per year is the estimated cost of a full-time employee, then the annual savings is $8,000 in productivity improvement (i.e., $25,000/.75=$33,000 versus the new $25,000 cost or an $8,000 in savings). The prototype assistance was simply cost-effective technical assistance.

Additional benefits include cost savings related to wind-tunnel usage, introduction of the margin hoop lift frame system, adhesive interface improvements, and prototype development of new umbrella parts.

Benefits from these Lake Erie MEP projects are summarized in Table 1.

Public Benefits

The public benefits are basic: 55 people employed in the inner city portion of Toledo—an area hit hard by the exodus of several Fortune 500 companies. The hire of at least five employees is associated with the Lake Erie MEP projects. The umbrella market is a competitive market, subject to external market conditions on the manufacturing side and the availability of low-cost labor and materials in Pacific Rim countries. Haas-Jordan and Westcott have been able to maintain employment levels

Table 1

Summary of LEMEP-related Cost Savings

YEAR	SALES	EMPLOYEES	SALES/EMPLOYEE	ANNUAL COST SAVINGS
1993	$5.5 MM	48	$114,583	
1995	$6.3 MM	55	$114,583	$10,000 wind tunnel testing savings
1995				$8,000 productivity improvement related to silk screening of large umbrella operation
1995				$20,000 incremental contribution of margin hoop lift frame system for large logos
1996				$6,000 projected economic impact for adhesive interface development
				$1,200 projected economic impact for prototype development of tip cup and sleeve
1996				$45,200 is realized annual benefit
1996				$12,686 is LEMEP income from all projects
1996				$3.56 is Haas-Jordan/ Westcott benefit from every dollar invested with LEMEP

and their contributions to the community of Toledo, Ohio, by seeking cost and quality leadership while recognizing the value of their work force.

Haas-Jordan's Quest for Quality and Its Partnership with LEMEP

David Waltz has a tremendous capacity for change and innovation, and has acted not only on LEMEP recommendations but on many of his own instincts in his quest for higher quality products and performance. Haas-Jordan's atypical status as a small company sourcing product in the Far East while constantly seeking customer input to continuously improve product lines testifies to his and the firm's ability to change in the interest of survival.

This quest also helped create the opportunity for Lake Erie MEP to be part of that change. Mr. Waltz is quoted as saying, "I issued a challenge to LEMEP to solve our testing problems and they responded with a cost-effective, viable solution. This reinforces to me that knowing the right people and having an effective network of resources will get the job done and done right"—clearly the attitude of a leader expecting to change as part of growing.

CHRONOLOGY OF SERVICES

February 21, 1995	•	Wind Tunnel Testing—Cost to Haas-Jordan: $3,000.
April 3, 1995	•	Automated Hoop Lift Frame System—Cost to Haas-Jordan: $8,817.
December 8, 1995	•	Adhesive Interface Development—Cost to Haas-Jordan: $200.
March 12, 1996	•	Prototype Development, Reinforced Umbrella Tip Cup—Cost to Haas-Jordan: $1,672
January 30, 1996	•	QuickView Plus Benchmarking—Cost to Haas-Jordan: $0.

- Cover letter of the January 30, 1996, final report
- The QuickView Bar chart
- The Lake Erie MEP value-added analysis and recommendations
- Vision for Haas-Jordan—a matrix of project opportunities

Case Study

ITHACA PERIPHERALS INC.

Ithaca, New York

ALLIANCE FOR MANUFACTURING AND
TECHNOLOGY (AM&T), FORMERLY
UNIVERSITY/INDUSTY PUBLIC PARTNERSHIP
FOR ECONOMIC GROWTH (UNIPEG)
an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Ithaca Peripherals Incorporated

Ithaca Peripherals Incorporated (IP) was started in 1983 by two engineers formerly with NCR. The company manufactures point-of-sale (POS) printers used for the printing of receipts and tickets. IP has four primary product lines that are sold either as discrete units or as components for larger POS systems. A total of 85 people are employed by the company, nearly half of whom are engaged in assembly, stock room, or shipping operations.

IP's competitors achieve economies of scale through production of large volumes of printers with standard features. These competitors are able to meet demand quickly and maintain low prices for a standard product. The challenge for IP is to achieve the same economies of scale and production cycle time while offering customers customization and product flexibility.

IP is order-driven, with short turnaround times for customized orders. The company is working toward a just-in-time production scheme. Production lines at IP are organized with a sub-assembly staging area adjacent to four production lines. The sub-assembled units and other components for the final assembly are collected in bin racks at the beginning of the production line. The lines are organized by printer model. Material costs are the most significant cost element to the company.

Until 1993, nearly 100 percent of the company's sales were in the United States and Canada. Since then, a new sales office has been opened in the United Kingdom, and overseas sales have increased as a percent of total sales.

Predecessor Conditions

The prevailing environment at Ithaca Peripherals had been that of a company whose systems and manufacturing operations had not kept pace with the firm's overall growth. IP had spawned several different departments that were dependent on each other but not fully integrated or operating on the same information.

The key issues identified at IP related to its manufacturing operations. In particular, the company was experiencing a high turnover rate in temporary employees, high costs associated with warranty returns, and a high rate of "first-pass" inspection failures. These issues appeared to be linked. Contributing circumstances included employee compensation below market averages, frequent use of temporary staff, and a nonintegrated management information system (MIS).

Technical Assistance Provided

The assistance IP received through the MEPaffiliated Alliance for Manufacturing and Technology (AM&T), formerly the University

Industry Public Partnership for Economic Growth (UnIPEG) can be categorized into two main components: assistance associated with obtaining IP support from New York State's Industrial Effectiveness Program (IEP), and subsequent technical assistance provided directly by AM&T.

First, AM&T assisted the company in obtaining an IEP grant to implement a new manufacturing operations MIS and to enact changes in the production process. (*The IEP is a non-MEP program funded by the former New York State Department of Economic Development, which is now called Empire State Development*). This work was completed by an outside consultant selected by IP. During the project, AM&T acted as broker/facilitator between the company and the consultant. In addition, AM&T provided administrative support with respect to program management, accounting, and reporting.

AM&T also provided direct services under the MEP, including independently assessing IP's business environment and identifying the company's additional requirements. The objectives were to provide the company with the tools to monitor and improve its product quality and manufacturing operations.

Both phases of AM&T's assistance addressed the same basic problem at Ithaca Peripherals: the need to make the transition from a "mom-and-pop" shop with non-integrated business operations to a company with integrated and interdependent operations.

IEP Assistance. In keeping with the role of New York State-based MEP regional affiliates, AM&T provided initial assistance with IP's application for financing through the IEP program. In addition, when funds were secured, AM&T provided project management during the full productivity assessment stage of the IEP. Its role was to assist in managing the consultant—IP relationship and to maintain the project's focus on the objectives outlined in the assessments.

The consultant selected to implement IEP improvements was Sigma Consulting of Rochester, N.Y. The work conducted by Sigma Consulting included two major components: system improvements, including implementation of a manufacturing-oriented MIS (Fourth Shift™) and manufacturing layout changes.

In the end, Ithaca Peripherals chose not to fully undertake additional work outlined in the IEP workplan. These tasks included a TQM program for senior managers and a system to measure vendor/supplier capability and product competitiveness. The unused portion of the $50,000 grant was approximately $13,000. A primary reason that IP opted not to undertake this work was that the company's priorities had changed since the initial assessment, making elements of the IEP irrelevant.

Manufacturing Strategy Plan. However, IP did continue to access the direct services provided under the MEP. Following completion of the IEP-funded improvements, an AM&T field engineer led the month-long development of a new manufacturing strategy for IP. Begun in August 1994, this new plan continued where the IEP assistance had left off, providing assistance to a new operations director in addressing ongoing issues concerning manufacturing operations.

The plan focused on operations because that was where the company needed to develop more direction and prioritize proposed solutions. The plan laid out the company's objectives and the tasks required to achieve each one. Each task was organized as a discrete service that the company could purchase.

The plan identified several key areas for attention, including the following:

- Staying abreast of competition with respect to price, quality, delivery, and product features.
- Monitoring main component supplier arrangements.
- Establishing a process to ensure a smooth flow of communications and to improve IP's facility with data requests, collection, analysis, and distribution.
- Reviewing the information system being developed under the IEP grant by Sigma to ensure compatibility of software and objectives, of the plan and its achievement, of system capability and utilization, and to evaluate the need for additional training.
- Refining manufacturing processes and inventory control procedures.

AM&T prepared and administered the manufacturing strategy plan in December 1994. The MEP program provided project overview, mission definition, and organizational advice. The plan provided a corporate vision statement, a corporate mission statement, and a list of immediate challenges to the business operations relative to product quality, delivery, employee skills, and morale improvement. The services and tasks performed under the manufacturing plan included those identified in the table below:

Table 1

Services and Tasks Performed Under the Manufacturing Plan

Manufacturing Plan Item	Objective	Deliverable
Quality Improvement (Final Report delivered 2/17/95)	• Establish time-phased targets. Develop methodology to collect data, perform root cause analysis. • Solicit in-house and customer feedback.	• Methodology to collect data, perform root cause analysis, and assure corrections are made.
Operations Team Management (Final Report delivered 1/30/95)	• Develop set of agreed measures. • Create methodology to display and track manufacturing processes.	• Specific measures for manufacturing team: — quality — cost — delivery

Source: AM&T and New York MEP "Manufacturing Strategy Plan" 12/2/94

Implementation of these tasks took place over the following six months and was completed during the third quarter of 1995. In addition to the tasks in the table above, AM&T assisted with developing a system for measuring customer satisfaction. This component grew out of the measurements and quality tasks. IP was considering a worker training element, but other priorities and a more stable workforce have dissuaded it from moving ahead with this task.

Changes in Manufacturing Practice

According to IP representatives, the major project components outlined above resulted both in improved manufacturing performance with respect to physical flows and in reduced unit costs and/or increased unit revenues.

The changes implemented under the IEP were related primarily to implementation of the "Fourth Shift" information system software and to changes in floor organization. The MEP direct technical service changes primarily related to the development of measurements and a quality improvement plan.

Fourth Shift™ Management Information System. The MIS implemented by Sigma Consulting created a framework for sharing information among departments and for distributing production data to staff and management. Before its implementation, each department used a different source of information for its individual operations. The new information system created an environment where purchasing, sales, and manufacturing decisions were made using the same set of data. Overall, the system facilitated better planning throughout the manufacturing operation.

Floor Reorganization. The floor reorganization included reversing the production lines, removing bottlenecks, and making general improvements to material and information flow. The new system included installation of a rack system with sub-assembled components and other parts organized in containers on the racks.

Development of Measurements. The development of measurements focused on the following process elements:

- Quality—as measured by the first-pass yield percentage at final test.
- On-time delivery—measured by the percentage of orders shipped on time.
- Customer satisfaction—based on direct feedback from customers.

A key element in implementing these measurements was that they be posted within view of all manufacturing employees. To relay this information back to the people who generate it, large charts are posted in the workshop directly in view of the production area. The charts are updated daily to reflect production output and quality of the units produced. When problems emerge, they are immediately visible on the charts.

According to company representatives, the implementation of productivity measures have resulted in the following process improvements:

- Quicker response to production problems. Discovery of problems is faster, and the time from problem discovery to cause identification is shorter.

- Improved materials planning. Inventory turnover occurs 4-6 times per year, with fewer delays from missing components.

- Improved scheduling. Greater visibility of the production process enabled more efficient scheduling and planning, allowing Ithaca Peripherals to maintain a competitive turnaround time on orders.

These improvements have led to savings from reduced warranty and "first-pass" repairs, while the company maintains its competitive advantage as a manufacturer of customized printers. Furthermore, as it grew and the labor cost component increased, the company was able to make more efficient use of its labor force.

Development of Quality Improvement Plan. The objectives of the quality improvement plan were to establish the following:

- Interim and long-term quality goals

- A data collection system

- A customer satisfaction system

- Root cause corrective action systems

The system for measuring performance, established in the first task, provided a basis on which to set quality standards and measure performance against them. AM&T provided the tools to measure performance and quality and to make continuous improvements by means of a feedback system that addresses problems as they arise. A new bar coding system is used in production to code rejected items, representing a move toward real-time identification of problems and their sources. Currently, tracking occurs just once daily. Bar coding is also used to track shipments.

Outcomes

Employment

- The use of temporary employees has decreased, and full-time staff has stabilized as a result of scheduling changes, software implementation, and improved management and process control.

- The number of engineers has increased, reflecting greater emphasis on R&D.

- The overall labor content in the manufacturing process is down as a result of more outsourcing. The goal is to have all vendors and suppliers within a 100-mile radius. Typical outsourced processes are cable manufacturing and board assembly.

- In 3 years, the number of full-time employees has grown to 20.

Production

- The company has maintained product reliability and quality.

- Improved materials planning has led to four to six inventory turns per year. Better materials planning and better forecasting, using real-time information, also has resulted.

- The company has expanded model types and offered customized features without compromising turnaround time or quality.

- The first-pass yield rate has increased through reorganization and new quality control procedures. The Model 50—the most popular model—had a 92 percent average first-pass yield in September 1994, improving to a 95-96 percent average yield by October 1995.

- There have been fewer warranty returns. (See Table 2).

Business Growth

- Business has grown steadily for Ithaca Peripherals over the past 5 years. While it is important to note that the market for POS printers grew during the 5-year period, IP representatives attribute a portion of the company's sales growth to the assistance received through AM&T.

- This assistance has helped IP develop a unique capacity relative to its competition: IP is able to fill orders for highly customized printers in a comparable time to their competitors who produce standard printers in high volume.

- Estimated savings from improved first-pass yield is approximately one employee, or $12,000 annually. Also, production and efficiency increases have resulted in additional savings yet to be calculated.

- The company estimates the total savings they experienced as a direct result of UnIPEG assistance at $30,000 in the first year alone. They believe the levels of savings will increase in subsequent years as new production systems are refined and all related feedback loops stabilize.

Table 2

Warranty Return Rate

	1993	1994	1995
Model A	50%	40%	5%
Model B	2.75%	2.65%	1.50%

Source: IP data

In addition to the efforts discussed above, a new operations manager was hired in 1994, partly on IEP recommendations. The agenda of the new operations manager included the following issues:

- Mistake-proofing assembly operations
- Quick change-over and pre-setup
- Standardized bench areas

The perceived benefit of AM&T intervention, from the operation manager's perspective, was its role as facilitator and ally during the period of change and new systems implementation. AM&T introduced new ideas and identified ways to improve operations. In addition, AM&T supported changes that the operation manager recommended to senior management.

Public Benefits

The assistance received through the MEP program strengthened the company and reinforced its competitiveness, helping it maintain a stable workforce. Although it has not hired many new employees, there has been a small increase in the more skilled and better-paying engineering positions.

Competing Explanations

Improved performance and gains in market share made by Ithaca Peripherals are due in part to overall industry growth and company expansion overseas during the period. However, IP's ability to enter new markets and maintain market share has been strengthened by MEP services.

CHRONOLOGY OF SERVICES

January 1993 - October 1995	AM&T Assistance for IEP Application: • Provided administrative and application support in making an initial assessment of the company and developing a list of consultants. • Identified company needs and helped the company obtain IEP funding to finance the changes required. • Completed the IEP application process.
April 1993 - October 1995	AM&T Project Management Assistance: • MIS design and implementation completed by Sigma Consulting. • Project management facilitated consultant-client relationship and maintained focus on the company's priorities managed by AM&T.
August 1994 - October 1995	AM&T Direct Service: • Identified new and remaining company needs. • Presented a plan including an estimate of costs.
September 2, 1994	AM&T Assessment Report: • Assessed the work done under the IEP program. • Identified and prioritized the company's remaining needs.
November 14, 1994	Meetings with new Operations Manager: • Established the company's needs in manufacturing process.
December 2, 1994	Manufacturing Strategy Plan: • Developed a strategy for the company to achieve its manufacturing objectives. • Outlined discrete tasks to be undertaken and assessed by the company in order of priority.
January 1, 1995 - January 30, 1995	Manufacturing Measurements: • Introduced a system to measure and track IP manufacturing processes. • Identified uses of the resulting data to continuously improve the system.

January 1995 - February 17, 1995	Quality Improvement Plan: • Provided tools to collect and use data and feed data back into the system to create an environment of "continuous improvement." • Changed manufacturing and management mentality.
March 1995 - April 1995	Customer Satisfaction Measurement: • Worked with sales to identify areas where manufacturing could improve. • Completed report in April 1995.

Case Study

KD DIDS, INC.

Bronx, New York

INDUSTRIAL TECHNOLOGY ASSISTANCE CORPORATION

an affiliate of the Manufacturing Extension Partnership

November 1996

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C A S E   S T U D Y

KD dids, Inc.

KD dids is a high-quality dancewear manufacturing company with 40 employees in Mott Haven, a neighborhood in the South Bronx of New York City. The company is located in an area targeted for economic development by both New York State and the Federal Empowerment Zone Program. KD dids has also received attention as a promising minority-owned company. For example, a *New York Times* article about the manufacturer was published in 1991.[1]

The company's presidents, David Lee and Trish Kaye, were professional dancers before starting the company. They became interested in knitting high-quality dancewear and started the company in 1980 in Oakland, California. In 1983, they moved the company first to Manhattan, and then, to take advantage of lower rents, the South Bronx, Initially, the company occupied the current office space for all of its operations, but eventually expanded deep into the building. KD dids remains a single plant operation but now occupies 12,000 square feet of fourth floor space.

Since its beginnings, KD dids has produced high-quality, "full-fashioned" knitwear.[2] This line of products has been quite successful. Recently, the company has also opened a line of cut-and-sew lycra dancewear that now accounts for 6-7 percent of sales.

KD dids has grown substantially since its origins. Growth was particularly strong during the early 1990's, when sales more than doubled. Its list of purchasers includes 500 retailers throughout the world, with a large concentration in New York and California. Approximately 20 percent of the company's sales are exported to foreign countries, including Europe and Japan. In 1990, the manufacturer employed 14 people; by 1995, it had 40 employees. Almost all its employees either currently reside or previously resided within a 10-block radius of the plant. All employees are cross-trained and new hires go through a 6-month training program. Employee turnover is extremely low, and employees are treated as a valuable and integral part of the company.

While KD dids' early customers were exclusively dancers, the company has gradually moved into non-professional markets as well, including aerobic fitness clothing. Its major competitors are large, high-volume dancewear producers.

Teaming Up With ITAC

A field engineer from the Industrial Technology Assistance Corporation (ITAC) first visited KD dids in December 1990. While ITAC has had ongoing contact with the company since that time, two projects stand out in terms of their tangible benefits to the company: assistance in accessing financing in 1992 and a productivity assessment and improvement project that began in 1994. The project was partially funded by a grant from the New York State Industrial Effectiveness Program (IEP). (The IEP is a non-MEP program funded by

the former New York State Department of Economic Development, which is now called Empire State Development).

Technical Assistance Provided

As is true of approximately 95 percent of its company relationships, ITAC initiates outreach and conducts informal assessments to identify opportunities for operational and productivity improvements. ITAC and manufacturers then work together to solve problems, scope out projects, and identify consultants to deliver the services. ITAC continues to provide guidance to the firm as well as to monitor the progress of all projects.

In the case of KD dids, ITAC provided assistance in two general areas: access to financing and productivity improvement.

Access to Financing. In 1991, KD dids was experiencing severe capacity constraints. A typical order took approximately 14 weeks to fill. The equipment consisted of several small, hand-held knitting machines and only one large, computerized knitting machine. Sales were going well, but back-orders were mounting. The company clearly required more productive capacity to meet the demand for its machine-knitted products. Unfortunately, the company did not have ready access to capital for several reasons: it had no previous credit history; most lenders had no confidence in the company; and it lacked knowledge of capital market resources. KD dids did manage to buy its first computer-controlled knitting machine with an $80,000 loan from a financing company. The loan terms, however, were "unfavorable," with a short lease and high interest.

In 1992, ITAC field engineer Phil Massaro was working closely with a large neighborhood-specific economic development agency, SOBRO, the South Bronx Overall Economic Development Corporation. Together, ITAC and SOBRO produced a targeted mailing to South Bronx businesses describing both agencies' resources. David Lee responded to the mailing and contacted Phil Massaro. Massaro recalled Mr. Lee saying he was "at his wit's end and not getting help anywhere." To raise capital, he was considering selling equity in the company—a premature step that might not have been advantageous to his company.

After assessing the key problems KD dids was experiencing, Phil Massaro was convinced that assisting the firm in obtaining financing for new equipment would help correct its severe back-order situation. Mr. Massaro introduced KD dids to Nancy Lasher from SOBRO. Although SOBRO had a service history with the company, previous interactions had been informal. KD dids' President, David Lee, said he would not have pursued SOBRO without ITAC's involvement. Ms. Lasher approached some 10 banks on behalf of KD dids before finding a receptive ear at Chase Community Development Bank, which provided the company with a $100,000 loan. The terms were much more liberal, with lower interest and no money down. The loan enabled KD dids to purchase a new [$80,000] computer-controlled, full-fashion knitting machine and much-needed, high-quality finishing equipment.

Productivity Improvement Project. In 1994, ITAC suggested that KD dids stood to greatly benefit from a comprehensive improvement project. To help defray the costs, ITAC helped the company obtain a New York State Industrial Effectiveness Program (IEP) grant, which it received in November 1994. ITAC assisted KD dids in selecting a private consultant, Tom Myers Associates, to implement the project. Mr. Myers conducted the initial productivity assessment and recommended the following changes:

- Improved productivity measurement
- Shop layout changes to accommodate a new cut-and-sew operation
- The purchase of four new knitting machines
- The hiring of a sales representative, a production manager, and a maintenance worker
- Expansion of "real world" software for accounting and production purposes
- Improved invoicing system linked to job batching
- Reassignment of two workers to improve product quality inspection

Changes in Practice

The ITAC-recommended consultant subsequently worked with KD dids to expand and diversify the firm's production capacity, reduce delivery time, and significantly improve overall manufacturing efficiency

New Cut-and-Sew Operation. While KD dids continues to primarily produce knitwear, it is also developing a new cut-and-sew operation. This new operation, together with increased knitting operations, required that the company expand into adjacent space in the building and develop a new shop layout. David Lee observes that product flow patterns in the shop had been "a big problem." He also feels that without ITAC's help in linking the company with experts to tackle these problems, KD dids would not have been able to expand its business in this way.

The cut-and-sew operations are continuing to evolve. KD dids has begun to produce some unique new dancewear that combines full-fashioned knitted and cut pieces in the same garment. The ability to combine these operation gives the firm a decisive competitive advantage over most competitors, but has complicated product flow through the shop. KD dids is meeting these production challenges with the assistance of ITAC and the consultant. The potential for increased sales in this area is considerable.

Finally, while knitting work at KD dids historically has been to fulfill current orders, the cut-and-sew operation creates a need for increased inventory. The consultant has assisted the company in addressing new inventory issues. As a result, KD dids is undertaking layout changes in both existing and new shop space. The consultant is working on completing a computer assisted design (CAD) layout plans and will be assisting in their implementation. These changes involve substantial new investment by the company.

Hiring of Sales Representative. As recommended, a sales representative with expertise in both the fashion and bodywear industries started working for KD dids full time in January 1996. Both the company's owners agree that hiring a sales representative will significantly help their competitive position. Most of KD dids larger competitors have a nationwide sales force.

New Software Packages. Previously, KD dids used "a hodgepodge of different word processing packages with no consistent tracking of production." The consultant is writing new software to support the production process. The package will track work from initial order to final shipment. Real World™ software, formerly used for accounts receivable/payable, is being expanded for use in other accounting areas.

Improved Productivity Measurements. KD dids has improved its productivity measurements through the following means:

- Implementing productivity measures such as "items produced per labor hour"
- Linking measurement to a new computer system
- Using the new system to identify and resolve bottlenecks in production
- Implementing single-entry accounting

Improved Invoicing System Linked to Job Batching. The company has revised its batching procedures. Batches are usually processed to equal one day's production for tracking ease. Each batch involves many jobs, each of which has a simple job ticket generated by the computer.

Outcomes

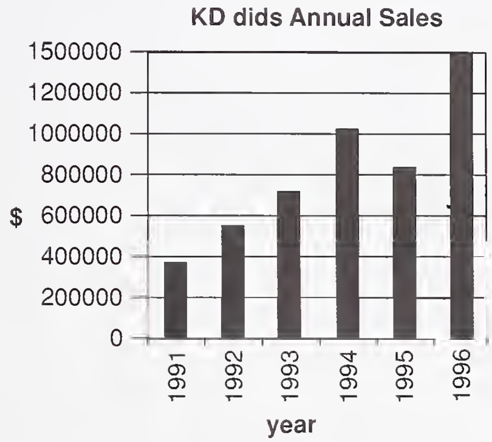
The business benefits to the firm associated with ITAC assistance

Doubled Sales. While demand for KD dids' products was high before ITAC became involved, the company was having a difficult time meeting it. The initial loan doubled KD dids' productive capacity, which, in turn, permitted the company to privately lease two more machines. Two years later, in the summer of 1994, the company privately financed four more machines, as capacity has once again doubled.

Thus, without this initial loan and the series of capacity expansions that loan ultimately enabled, KD dids would not have been able to meet growing demand. Instead, as the following chart illustrates, KD dids was able to double its sales during the period of ITAC involvement (1991-1995), and, further, projects record sales of $1.5 million in 1996.

Decreased Order Time. Order turnaround time was a fundamental problem for KD dids. Apparently, the company was known not only for the high quality of its products, but also for the long delays in delivery. David Lee was aware of this problem and the public's perception, and knew that his company had to restore credibility in this area. Changes resulting from ITAC's

intervention have brought delivery times under control. Order time has decreased from about 14 weeks in 1993 to approximately 3 to 4 weeks today, in 1996.



1993 figure estimated from 3rd quarter performance
1995 figure from New York MEP survey
1996 figure is projected

The company enjoyed some significant additional, though less tangible, benefits from its improvement program during an unexpectedly difficult 1995 when both its sales and profits fell. A number of factors contributed to these difficulties, including the failure of two anticipated contracts with high-end specialty department stores to materialize; release by several major dancewear brands lines very similar to KD dids; the loss of the firm's traditional sources of yarn supplies; and sales decline and product overstocking of such magnitudes that caused many small retailers to have trouble "keeping their heads above water."

Further complicating the situation was KD dids lack of a sales force to combat the competition, and the need to invest substantial sums to implement the new layout and other productivity improvements.

In reflecting on the situation, David Lee commented that, in 1995, KD dids was in a stronger position to overcome these liabilities than it would have been if the improvements had not been implemented. The company's increased efficiency and new cut-and-sew products proved two important elements of the firm's efforts to respond to this market situation. This successful response has brought sales "back to the levels they should be"—back, in fact, to record levels.

Of further assistance during this difficult period was continuing, informal consultation with ITAC. David Lee, the company's president, noted: "The ITAC consultant was there for us in tough times and gave us a lot of advice."

KD dids Opens Its Own Retail Store. Finally, in 1995, KD dids opened its first downtown Manhattan store to foster customer loyalty, promote its new line of active wear, conduct test marketing, and maintain a "presence." It is also planning to revitalize its mail-order business to sell directly to customers in areas presently not served by retailers who stock bodywear and dancewear.

Public Benefits

Hiring of 26 Additional Employees. Most of the new employees hired over the years are from the south Bronx neighborhood in which the company is located. Mr. Lee indicated that most of his employees reside within a 10-block radius of the plant and that many walk to work. KD dids has therefore created jobs in an economically

depressed area. The majority of its employees are ethnic minorities and most are women.

Finally, KD dids has worked hard to support its employees. It has never laid off any employees, some of whom have been allowed short leaves of absence to tend to family matters. They were able to do so because their co-workers had been cross-trained to perform different manufacturing operations.

Additional Tax Revenues from Increased Sales. Growth at KD dids has increased corporate and personal state and federal tax bases. While it is not feasible to quantify the impact of ITAC's work with KD dids on these tax bases, an impact clearly exists.

Competing Explanations

Competing explanations of the benefits attributed to ITAC are possible, but do not necessarily detract from the benefits described above. First, ITAC was one of two players involved in assisting the company in accessing financing. The second organization involved was SOBRO. While it is clear that both organizations cooperatively worked to access the funding, it is difficult to conclusively calculate the benefits derived from one of the organizations alone. However, it is ITAC's opinion that the combined efforts of both organizations enabled the company to obtain financing. ITAC believes that its ability to understand the technology involved and to communicate the potential impact of the new machines convinced SOBRO to pursue financing for KD dids. It is evident that a causal relationship existed between ITAC's intervention and KD dids' access to financing.

In addition, KD dids' increased sales were principally a result of having a strong product with strong market demand. ITAC's assistance enabled the company to better meet this demand. Sales are linked to the firm's ability to deliver goods on time. Without increased capacity and better delivery times, KD dids would not have been able to meet customer demand, which might have caused a decrease in sales. Additionally, the positive impact of combining full-fashioned knitting with cut-and-sew operations would not have been realized without the assistance the company received.

Looking Back

David Lee, in looking back on his interaction with ITAC, stated: "If we had to do things all over again, we would do it exactly the same way....ITAC provided us with invaluable assistance and access to resources" which " helped us move from being a 'mom-and-pop' operation to a streamlined manufacturing business. . . We have become more growth-oriented."

Moreover, Co-President Trish Kaye adds: "ITAC has given us access not only to funding and technical resources, but their expertise has expanded our viewpoint."

From the ITAC perspective, field engineer Phil Massaro noted that the key to successful work with KD dids had been the company's openness to new ideas and progressive approach to doing business. This attitude had permitted ITAC "...to help a small company that had a terrific product but didn't have the know-how necessary to successfully expand its business."

CHRONOLOGY OF SERVICES

early 1980's	• KD dids is founded by Trish Kaye and David Lee. Company moves to Mott Haven, South Bronx, NY.
December 1990	• ITAC field engineer first visits company.
1991	• KD dids experiences severe capacity constraints and can not obtain favorable financing for new equipment.
1992	• ITAC and SOBRO assist KD dids obtain $100,000 for one new knitting machine and finishing equipment.
1992	• KD dids is able to privately finance the leasing of two more knitting machines.
1993	• Sales continue to increase but KD dids is back ordering customers. ITAC recommends comprehensive productivity improvements.
1994	• ITAC assists KD dids to scope work, select private consultant and obtain IEP grant. Company-wide assessment is conducted by Tom Meyers Associates. KD dids purchases four additional knitting machines. Capacity has quadrupled since 1991.
1995	• KD dids begins to implement productivity improvements including, new shop layout to accommodate new cut-and-sew operation, upgraded computer hardware and software invoicing and job batching. Order turnaround time has decreased from 14 weeks (in 1993) to 3-4 weeks (in 1995). KD dids open its own retail store in lower Manhattan.
January 1996	• KD dids hires new sales representative.
1996	• ITAC continues to provide guidance and access to technical expertise and modernization resources to KD dids. KD dids continues to invest in its workforce, productivity improvements and growth.

Endnotes

1. "Growth Amid Blight: Uneasy Worlds Coexist," New York Times, Metro Section, November 7, 1991.

2. "Full-Fashion" knitwear involves no cutting of fabric in its production, resulting in smaller, stronger seams that are ideal for dancewear.

Case Study

KINTZ PLASTICS, INC.

Howes, New York

CENTER FOR ECONOMIC GROWTH

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

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Belmont, Mass.

and

Center for Economic Growth (CEG)

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CASE STUDY

Kintz Plastics, Inc.

Kintz Plastics is a thermoforming manufacturer of large plastic components in rural New York State. It produces covers and cases for large machines, including medical devices, components of large products such as train cars and electronic appliances, and specialty products such as an aroma-therapy spa. Job orders are typically of low to moderate volume, that is, in the hundreds or thousands.

The company's primary manufacturing processes are plastic thermoforming and computer-numerically controlled (CNC) machining. Because of its isolated location, however, the company undertakes many additional operations that might otherwise be contracted out. These include aluminum mold development and product assembly, painting, and decal work.

The company was established in 1976 and has since grown in both size and stature. Kintz Plastics is the only heavy- gauge thermoforming manufacturer in the United States with ISO-9000 certification.

Mr. Kintz is the incoming president of the Society of Plastic Industries Thermoforming Institute. Over the past four years, Kintz has earned the distinction of being one of the top companies in the industry. It recently opened a second small manufacturing facility in Florida, where many of its buyers are located.

Kintz and the New York Manufacturing Extension Partnership

Wynn Kintz first made contact with the New York industrial extension program in the early 1980's—near the inception of manufacturing extension services in New York. The company has maintained connections with the state extension service throughout the program's subsequent evolution, including its progressively fuller (and now full) affiliation with the national Manufacturing Extension Partnership (MEP) program. Ongoing program support to Kintz, including referrals and problem solving, has been provided over the years by various field engineers.

On his part, Mr. Kintz has provided leadership and support to the program. Among his contributions is service on the Board of Directors of the Center for Economic Growth (CEG), one of New York State's current MEP affiliates. He also has helped nurture a process of relationship-building among a loose consortium of companies and public agencies.

Technical Assistance Services

Four primary services were provided to Kintz Plastics through New York MEP and its predecessors, as described below.

MIS and CAD/CAM Project. In 1990, Kintz received its first direct exposure to MEP assistance in conjunction with a project to develop a new

job-tracking management information system (MIS) for purchasing, inventory control, job ticketing and routing known as SYMIX. The New England Manufacturing Technology Center (NEMTC), the first MEP-funded New York State organization, provided project management assistance to Kintz in operationalizing this new capability. The system enabled major changes in the company's purchasing and manufacturing practices.

In conjunction with this MIS effort, NEMTC also demonstrated to Kintz a package for advanced computer-assisted design and manufacturing (CAD/CAM). Previously, the company had made aluminum thermoform molds through manual programming of cutting tools. This was a time-consuming process that required a number of skilled designers. NEMTC's demonstration gave Mr. Kintz his first "hands-on" exposure to the technology—an aspect of the program Mr. Kintz appreciated. He soon adopted the technology for his own operations.

Floor Plan Design. A new shop-floor layout and design was the first project performed directly for Kintz Plastics by CEG. In 1994, Kintz Plastics was preparing to expand its operations into a 9000 square-foot extension. It planned to establish a new work cell in the space for the production of large molded products, but needed assistance designing the layout for maximum efficiency. CEG located expert design help for the company through the Hudson Valley Community College, which designed the new layout for a cost of $2,200.

Technical Assistance with New Product Mold. During the period that CEG was assisting Kintz Plastics with the new workspace layout plan, an unusual problem emerged. A new customer asked Kintz Plastics to bid on two new products for which no exact specifications existed. The parts were single and double versions of a mount for high-performance automobile gauges for after-market sales in Japan. With only a rough composite model that had no flat edges to reference, the design was particularly difficult to render. Kintz Plastics did not own the laser measurement equipment necessary to render exact design specifications to machine the molds.

The CEG field engineer located the resources necessary in a former New York MEP client company elsewhere in the state. After making the necessary arrangements, he took the models to the other company and used its machine for a nominal fee. Overcoming difficulties in measuring the peculiar part, the engineer returned digital models of both parts to Kintz Plastics just four business days after receiving them.

With the quick response of CEG, Kintz Plastics was able to return a bid for the contract after one week. Because the digitizing equipment was prohibitively expensive at $200,000, it is unlikely Kintz could have bid the job without CEG's assistance.

Reduced-Fee ISO-9000 Certification. In 1995, Kintz Plastics was the first of 10 companies to sign up for an ISO-9000 certification course and registration arranged by CEG. In addition, CEG provided Kintz Plastics with an initial audit to identify issues that would affect its certification.

The course and registration, provided by KPMG Peat Marwick, would normally have cost $30,000—$40,000. CEG arranged for a group discount rate of $10,000 per company. While Mr. Kintz does not believe he would have paid full price for the certification process, he was willing to pay the group rate.

Changes in Manufacturing Practice

With the new job-tracking and machining systems in place, Kintz Plastics substantially increased its productivity and greatly enhanced its up-front design work, mold tooling, and manufacturing throughput. Mold development time was cut dramatically. Molds that formerly took as long as a month to complete now took a week. Currently, the CNC cutting tools can work continuously for up to 30 hours on a complex mold form with little involvement of the CNC operator. The SYMIX system allows comprehensive job tracking throughout the many stages of manufacturing.

In the short term, the company was able to reduce its mold design staff from six to two. In the long term, the increase in capacity resulting from the new system contributed to the company's growth from 95 employees in 1992 to 110 in 1994. For the same period, manufacturing lead time was reduced from 70 to 56 days; the product scrap rate was reduced from 6.0 to 4.2 percent; and customer rejects were reduced from 2.3 percent to 1.2 percent.

The new shop-floor layout was a key component in effectively using Kintz's new workspace, which now also houses production of an enclosed, free-standing steam and aroma-therapy spa designed for two people. This layout helped improve workflow and overall plant efficiency, including reducing the movement of work in progress, much of which involves large components.

Finally, through the CEG-arranged ISO certification course in 1995, Kintz Plastics became the first heavy-gauge plastic thermoformer to get ISO-9000 certification.

Outcomes

Mr. Kintz reports that the company has more than tripled its sales from $2 million in 1990 to $7.5 million in 1995. The company attributes some of this growth to New York MEP programs. It estimates that its investments of approximately $100,000 in MEP-affiliated improvements have produced $2 million in benefits. For 1995 alone, it estimates that CEG was responsible for $600,000 in sales. This $600,000 includes $50,000-$100,000 in new export sales of high-performance automobile gauges to Japan, a result of winning the contract on which CEG assistance enabled Kintz to bid.

Further, ISO certification has enhanced significantly Kintz Plastics' reputation as a top-quality manufacturer. For the past 4 years, the company has been distinguished as one of the top heavy-gauge plastic thermoforming companies in the United States.

Mr. Kintz, summarizing the effect on his business of collaboration with NYMEP, stated that the new systems changed Kintz Plastics "from a computerized job-tracking and machining mom-and-pop business to a real company." He added:

"We're very appreciative of CEG services and quite frankly it has made us a better company. And I'd tell anyone that."

Public Benefits

Despite a brief reduction in employment, the company's gains in productivity and capacity have driven the creation of over 50 jobs since 1990.

In addition, by contributing to increases in the corporate and personal tax base, CEG's activities at Kintz Plastics have helped generate increased public revenue.

CHRONOLOGY OF SERVICES

1990-91	• Introduction of new MIS system SYMIX Project management overseen by CEG predecessor NEMTC. • Kintz receives demonstration of CAD/CAM design software for CNC mold tooling from NEMTC. The company adopts the technology.
December—January 1995	• Kintz requests assistance with an expansion plan and CAD layout design. Referred by NYMEP to Hudson Valley Community College. Services produce new floor layout, work staging areas, other work stations, and a system for work-flow analysis.
January 1995	• Kintz requests CEG assistance with production of two thermoform molds for automotive gauge holders—specifically, assistance to digitize rough models for mold development. CEG field engineer quickly locates a resource, oversees the digitizing process, and delivers the computer model to the company. Kintz secures the contract as a result.
1995	• Kintz participates in the ISO-9000 certification process, arranged by CEG at a cut rate through KPMG Peat Marwick. Kintz became the first ISO-registered U.S. company in heavy-gauge plastic thermoforming industry.

Case Study

LUITPOLD PHARMACEUTICALS, INC.

Shirley, New York

LONG ISLAND FORUM FOR TECHNOLOGY

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Douglas Welch

Nexus Associates, Inc.

Belmont, Mass.

CASE STUDY

Luitpold Pharmaceuticals, Inc.

Luitpold Pharmaceuticals manufactures and packages generic injectable drugs for use in hospitals. The company employs over 300 people at its facility in Shirley, New York. In 1994, total sales for the company exceeded $50 million. The company's principal activities include mixing 55 unique formula drugs and packaging them to government specifications.

Competition in the generic pharmaceuticals industry is high. The business is order-driven, but pricing is under contract between buying groups and the pharmaceutical companies. For each product, Luitpold has roughly six competitors. Contracts are awarded primarily on the basis of cost. However, quality and ability to deliver also influence the bidding process. Materials constitute the most significant cost component at roughly 86 percent of total direct costs. Controlling materials flow is therefore critical to keeping operating costs low.

Identified Inefficiencies, Potential for Change

Before Luitpold began working with the Long Island Forum for Technology Inc. (LIFT), an affiliate of New York Manufacturing Extension Partnership (MEP), the company's key concerns related to inefficiencies in its production line. In many cases, the company did not have the tools to measure these inefficiencies or the costs resulting from them. By the same token, there was no system in place to identify the causes of inefficiency or to take remedial actions. Inefficiencies in the production line had other effects as well, particularly on the following areas:

- High volumes of work-in-progress
- High scrap rates
- The company's ability to meet earnings projections
- Production overruns
- Delays in production line changes for the filling areas
- Inability to identify a problem or its source

In production management's view, many of these inefficiencies related to government regulations and could not be overcome. In addition, management did not see any potential for real cost savings. Luitpold was fully engaged with meeting orders and did not have the resources to commit to fine tuning its processes.

In September 1993, a LIFT field engineer met with Luitpold. His effectiveness in communicating with

Luitpold's management was due in part to his success as both an executive and engineer in the semiconductor industry. The field engineer convinced Luitpold's management that changes were possible and that the company could improve its manufacturing process.

Technical Assistance Provided

Assistance with Securing IEP Funding Support. First, LIFT staff assisted Luitpold Pharmaceuticals in completing an application for assistance from the Industrial Effectiveness Program (IEP). The IEP is a non-MEP, New York State government financing program which supports modernization efforts by in-state manufacturers. This application, the product of a collaborative effort by LIFT and Luitpold to identify and prioritize company needs and potential improvements, outlined a proposed scope and projected cost of work to be performed.

Consultant Selection and Oversight. Once the assistance had been approved, the LIFT field engineer helped the company select a consultant to provide a Full Productivity Assessment (FPA) of Luitpold's operation. The consultant ultimately selected by Luitpold offered an additional incentive: a guarantee that financial benefits from project implementation would exceed total costs.

Under the FPA, begun in April 1994, the consultant's principal focus was to develop a system to comprehensively track materials flow. Information from this new tracking system ultimately would enable Luitpold to significantly improve its manufacturing operations.

Throughout the project, LIFT fulfilled a mentoring role by attending consultant-client meetings and maintaining the focus of the project. In March 1996, 6 months after completion of the project, LIFT was to help Luitpold evaluate the project's effectiveness and publicize the results, focusing on bottom-line impacts.

Changes In Practices

Prior to the FPA, Luitpold lacked an effective system to collect and use production data. The changes introduced by the consultant yielded these results:

- Established material flow and production tracking systems
- Provided production data to those responsible for controlling the process
- Established work-to-time relationships

The material control system included software to track production information and identify and correct problems in the manufacturing process. A key element of this change was putting this information in the hands of the people controlling the processes.

The assistance entailed no dramatic changes to shop-floor organization or manufacturing processes. Instead, service was oriented to developing and reorganizing production-line information. By developing tools to enable it to monitor work-flow and to associate processes with costs, the company gained a valuable new operations management capability. By applying this new capability, Luitpold was able to identify, and subsequently undertake, a series of incremental, but important, improvements to their production systems.

Outcomes

The new system provided Luitpold management and workers with the capability to improve process management, control production, and quantify associated costs and savings. According to the firm's vice president of manufacturing, positive outcomes included the following:

- Reduced unit cost of production
- Increased productivity per employee
- Reduced labor cost through reductions in overtime
- Reduced material purchases
- Reduced scrap rate

For calendar year 1995 alone, the company estimated it saved approximately $710,000 in total production costs. These savings did not result from any decline in production or employment, as Luitpold's sales continued to increase during the period of LIFT involvement while its employment level remained stable.

According to both Luitpold and LIFT representatives, Luitpold's cost savings are a direct result of the services that LIFT and the consultant delivered. Neither organization believes Luitpold would have undertaken the production changes yielding these productivity gains without this assistance.

To implement the changes recommended through LIFT, Luitpold executives estimate the company spent $256,000 through the end of 1995. This constitutes little more than a third of the project-related savings it received over the same period.

Public Benefits

The public benefits of changes made at LIFT occur in two key areas:

1. Increased employment security for more than 300 persons due to improved company competitiveness
2. Increased corporate and personal tax revenues due to increased plant productivity

CHRONOLOGY OF SERVICES

September 1993	LIFT introduced services to Luitpold

- LIFT field engineer makes initial site visit to Luitpold.
- Company is made aware of the IEP program and available funding.

October - December 1993	Pre-Project Assessment

- Company needs and potential improvements are identified and prioritized.
- Company is assisted with IEP grant application.
- Consultant is selected to conduct FPA.

April - August 1995	FPA started

- Field engineer attends consultant-client meetings.
- Project focus is centered on company's needs.

September 1995	Services completed
March 1996	LIFT follow-up/evaluation

- LIFT evaluates impacts of services administered under the IEP.

Case Study

MARPLEX, INC.

Rhinelander, Wisconsin

NORTHWEST WISCONSIN MANUFACTURING OUTREACH CENTER

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Orville Nelson

Northwest Wisconsin Manufacturing Outreach Center

Menomonie, Wis.

CASE STUDY

Marplex, Inc.

Marplex, Inc., (Marplex) is located on the north side of Rhinelander, a city of approximately 8000 residents in the heart of Wisconsin's forest lands. It converts logs into grade lumber, crating, and pallets. The company is privately owned and operates as a separate entity. It currently employs approximately 125 people. As a result of its location, Marplex has ready access to logs and lumber. Some lumber is purchased from area companies when there is an insufficient supply of logs, or a need for special materials, kiln-dried lumber, or special cuts.

Major products manufactured by Marplex include grade lumber, cut stock, skids, and specialized wood crating and wood pallets. Each year, the company converts over 20 million board feet of mixed dense hardwood logs into specialized crating and pallets. By-products and scrap from its manufacturing operations are processed and sold to area companies. Scrap lumber and wood are turned into chips and sold to a paper mill. Bark is purchased by landscaping companies, and sawdust is used as a fuel by area companies. The main portion of the Marplex plant was built in the mid-1960's. The sawmill portion of the plant was destroyed in a fire in 1987 and rebuilt in 1988. A new dimension sawmill was added in 1994. This mill allows Marplex to produce grade lumber and longer length materials.

Marplex does not handle the logs until they are delivered to its plant site. From that point on it processes the logs through various operations until it produces dimension lumber for grade, cut stock, specialized crating, and pallets for its customers. Operations done in the plant include debarking, sawing the logs into boards and dimension stock, cutting the lumber into parts for pallets and specialized crating, fabricating the products, and packaging them for delivery.

Marplex does not own the trucks that are used to deliver final products. It has forklifts, log handlers, and front-end loaders to move logs and lumber at its plant site. Forklifts are also used to load the final products.

Need for Assistance

Marplex has grown in size over the past 30 years and had added to its plant in a piecemeal fashion as it needed space. Thus, there was a need to improve plant layout, materials handling, and production systems. The company experiences higher freight costs because it is located further from its customers than its competitors. In addition, its labor costs tend to be higher than those of its competitors.

Intense competition for the logs available in the area was also creating cost pressures for the company. Reduced timber harvesting on federal- and state-owned lands and the growth of small sawmill operations had created a tight supply of logs. Thus, a need existed to use purchased logs more efficiently and reduce processing costs.

Additionally, Marplex was concerned with environmental issues. The plant is located within approximately 500 feet of the Wisconsin River. Its plant site has a large area on which logs are stored in preparation for processing. Company management was concerned about the impact of its operations on the environment and needed to develop a storm-water pollution plan for the company.

Prior to the time the Northwest Wisconsin Manufacturing Outreach Center (NWMOC) started to work with Marplex, the company had ordered an automated nailing machine for its pallet line. This addition created a need to review its pallet manufacturing system and determine the best location for the machine.

Therefore, Marplex was seeking to become more efficient and reduce its manufacturing costs, while simultaneously addressing environmental concerns, when it contacted the NWMOC.

Technical Assistance Areas

NWMOC provided nine separate technical assistance projects to Marplex. These projects, summarized in Table 1, were conducted from April through early November 1995 and focused on the following six areas:

1. Human Resources—value-added manufacturing (VAM) training sessions

2. Plant Layout/Manufacturing Cells

3. Environmental—assistance in developing a storm water pollution prevention plan

4. Process Improvement

5. Preventive Maintenance (PM)

6. Risk Control Assessment

The general process used by the NWMOC staff to develop and change practices at Marplex involved the following steps:

1. Discuss the problem with plant managers.

2. Observe/collect data on the problem area.

3. Analyze the data and prepare tentative solutions.

4. Discuss tentative solutions with plant personnel and select the best one. This process involves a team approach.

5. Revise and refine the solution.

6. Discuss revised solution with Marplex team.

7. Assist with implementation.

The resulting changes in Marplex capabilities are summarized in Table 2.

Table 1

Capacity For Change Created By NWMOC Technical Assistance

Technical Assistance Areas	Technical Assistance Provided	New Capacity for Change
Human Resource Development (1 TAP)	• Eight mini value-added manufacturing sessions were conducted for Marplex employees. Each employee attended a VAM session.	• All employees are aware of the VAM strategy. • Many employees have experience in applying VAM.
Plant Layout (2 TAPs)	• Documented facility and machine footprints. • Formed product cells. • Marplex has functioning • Helped rearrange equipment. • Implemented improvements in dust collector system.	• Marplex has a computer assisted design (CAD) database of its assets. production cells. • New automated nailing machine was located in a flow-through design. • Managers developed a knowledge of manufacturing cell design and flow-through manufacturing principles.
Environment (2 TAPs)	• NWMOC staff assisted in identifying components needed in the company's storm-water pollution prevention plan, acquired information needed to develop the plan, and helped to outline the plan. Nicolet Area Technical College students did a complete survey of company property and developed a contour map.	• Marplex management has a better knowledge of how to manage its operations to reduce and eliminate pollution from its facility. Also, it knows where to seek information and assistance in this area.
Process Improvement (2 TAPs)	• Assisted in the redesign of the infeed system for Plant 3. • Designed fixtures to facilitate quick changeovers.	• Managers have an expanded knowledge of flow-through manufacturing concepts and the value of CAD in visualizing solutions. • Plant managers are more knowledgeable of techniques used in quick changeovers and how to reduce bottlenecks in manufacturing systems.

Table 1 Continued

Technical Assistance Areas	Technical Assistance Provided	New Capacity for Change
Maintenance (1 TAP)	• Revised and assisted company in implementing preventive maintenance (PM) checksheets and procedures for mobile equipment. • Designed and implemented several continuous improvement projects related to recycling, plant hygiene/housekeeping, and workplace organization. • Developed prestart checksheets to assist operators in identifying needed repairs before equipment is used.	• Plant employees have developed the capacity to do PM checks and take appropriate action. Oil and grease spills have been reduced. • Employees have expanded knowledge of how to handle and store materials used in production processes and how to maintain safe working areas. • Maintenance staff and managers learned how to collect and analyze data to determine when PM is needed.
Risk Control (1 TAP)	• Performed a risk control assessment at the plant.	• Management is aware of a number of ways to reduce the stresses caused by repetitive motion and lifting.

TABLE 2

General Changes in Marplex Capabilities

• Developed the ability to use the VAM approach in the design and redesign of manufacturing systems, a paradigm that can be used as part of the company's decision-making.
• Acquired a systematic problem-solving process.
• Developed an understanding of the use of CAD in visual problem solving.
• Expanded its capacity to access outside information and technical resources.

CAD Blueprint Database. The company did not have formal documentation and blueprints for most of its facilities. As a result of the work of NWMOC staff, it now has a computer-assisted design (CAD) database of its assets and drawings of its facilities.

Introduction of Manufacturing Cells. Marplex wanted to become more responsive to its customers' requests. To do this, its manufacturing systems had to become more productive and flexible to be able to handle smaller batch sizes. Just-In-Time (JIT) manufacturing principles were applied to accomplish these goals.

NWMOC staff members observed the manufacturing processes and systems used in Plant 1. They developed flow charts of the process and activities involved in producing each of the products. They also documented facility and machine footprints.

Alternative equipment layouts were developed from this information. The resulting bubble diagrams were discussed with a team of Marplex employees and managers. Marplex made the decision to rearrange the production line for its highest-volume product into a cellular layout, which reduced materials handling and work in process. The new, automated nailing machine was placed near the shipping area. The new layout reduces work in process and the distance materials travel. In addition, new jigs and fixtures were designed to reduce changeover time. Layout options for future business growth were also developed and presented, including expansion of manufacturing into a cold storage area, improvements to loading docks, and changes in office space.

Dust Collection System. As these changes were being made, the dust collection system was also redesigned to improve its effectiveness and eliminate downtime. Some downtime had been experienced because the old system would plug up. The NWMOC project manager worked with vendors and a team from Marplex to redesign the dust collection system.

Storm-Water Pollution Prevention Plan. Two of the technical assistance projects were associated with the preparation of a storm-water pollution prevention plan. Marplex was required to develop and submit a storm-water pollution control plan for its property by the end of December 1995. Developing this plan involved reviewing a number of documents, and assembling information by the Wisconsin Department of Natural Resources (DNR). Implementation of this plan will reduce the potential of pollution problems in a geographic area noted for its recreation and tourism, and will help identify solutions to any problems noted. Marplex did not have the specialized resources needed to carry out the required land survey, nor did it have time to review all of the related documents to determine what was relevant for its plan. It thus needed assistance in identifying information and resources with which to create the final plan.

NWMOC staff reviewed the Wisconsin DNR documents and isolated the critical factors that

needed to be considered in developing the plan. Students from Nicolet Area Technical College, one of the NWMOC partners, surveyed the company property and developed a site map.

After this information was assembled, Marplex contracted with a company specializing in developing these plans. The consulting company used the information assembled by NWMOC staff to complete the plan. Marplex managers remarked, "The assistance of the NWMOC staff was very helpful in developing the plan. Our daily tasks do not leave us a lot of time to spend reviewing complex documents and trying to find outside resources to develop a plan such as this." The consultant company also reported that the information was useful and reduced the amount of work it had to do.

Redesign of Sawmill Infeed System. Two process improvement projects related to the sawmill infeed system were completed at Marplex that had a significant impact on productivity and also will have a long-term impact on how plant managers and employees approach process redesign in the future.

With the original log infeed system for Plant 3, logs were placed on the infeed deck, which extended outside of the building. The logs entered the building and were raised on a quadrant feeder to a conveyor belt. The conveyor belt transported the logs to the vertical elevator located at the infeed end of the saw. From the vertical elevator, the logs were placed on the singulator to keep them in single file. Logs moved off the singulator to the belt conveyor into the twin band saw.

Marplex experienced a number of problems with this system. The quadrant feeder had significant maintenance problems with hydraulic cylinders needing frequent replacement. One person had to be assigned to the system to monitor and reduce infeed problems. This problem was identified by Marplex as a high-priority area. The NWMOC project manager reviewed the problem with plant managers. Applying the principles of value-added manufacturing, they concluded that the conveyor system from the original infeed deck to the vertical elevator did not add value to the manufacturing process. It was decided that moving the infeed deck to the infeed end of the sawmill would allow the logs to move directly and smoothly into the sawmill's infeed conveyor.

Because the new infeed deck and the equipment needed to raise the logs to the sawmill had to be designed into the existing facility, the NWMOC project manager brought the NWMOC CAD specialist and CAD equipment to the Marplex plant. Marplex did not have CAD equipment or a CAD operator who could assist with the design work. The two NWMOC staff members worked with Marplex managers to develop a tentative design for the new infeed system. In the new system, logs flow directly up from the infeed table to the infeed conveyor belt for the sawmill; thus it was possible to eliminate the quadrant feeder and the horizontal conveyor belt from the system. However, the new system had to fit with the existing location of the sawmill, the outer walls of the facility, and two concrete pillars that could not be moved. NWMOC staff collected measurement data and developed an initial design. Marplex staff were able to view the design and make suggestions. Various changes were tried and resulting layouts discussed.

Marplex decided to implement the design and make changes. The manager directly associated with implementing these changes commented that, "Everything fit as designed. We did not have to make any significant changes." Logs are now loaded on the infeed deck, moved into the building, and placed in single file by the singulator. At the end of the singulator they are dropped one by one on the vertical ladder.

Preventive Maintenance Techniques and Risk Control Assessment. NWMOC staff jointly developed several preventive maintenance (PM) techniques with the maintenance staff at Marplex, discussing record keeping, checksheets, and preventive measures. These actions have led to fewer oil and grease spills, more appropriate handling of waste materials, and more preventive maintenance. NWMOC also conducted risk control assessment with an emphasis on ergonomics in the plant, offering several suggestions to reduce the stress from lifting, repetitive movements, and vibration.

Outcomes

The redesign of the infeed system for the sawmill in Plant 3 resulted in significant savings in down time and employee time used to monitor the infeed process. The maintenance supervisor commented, "We have eliminated at least 80 percent of the down time on the infeed system for that sawmill." As a result of the improvement in this system, the company was able to reassign one of its employees to a job in another part of the plant.

In addition, removing the quadrant feeder from the system significantly reduced the amount of maintenance that must be done. The maintenance manager estimated that it had taken an average of 12 hours per week to maintain the quadrant feeder.

The Marplex management team was satisfied with the new infeed system's effectiveness. They also noted that the assistance of NWMOC staff was helpful and critical in several areas. The CAD skills, software, and equipment brought onsite by staff was identified as being especially helpful in developing a visual solution to their problem. Marplex staff commented that the instant design changes, made possible by CAD, were very helpful. They were able to see several possible solutions in a short period of time and select the one they thought to be most functional. This solution was later slightly refined and implemented. The installation occurred without major problems. The new system has worked effectively.

Marplex staff also noted that it was helpful to have NWMOC staff with technical and engineering backgrounds available to them. As a consequence, the NWMOC staff could focus on the problem area, gather information, and develop tentative solutions, and thus avoid diverting Marplex staff from managing ongoing activities and resolving emergencies.

As a result of the work in developing their storm-water prevention plan, Marplex decommissioned a conical burner in June 1996 to reduce air emissions. New snow storage procedures have

been put into effect to reduce the potential of run-off pollution. In addition, its dust collection system does a more efficient and effective job of capturing sawdust and dust from its operations. New housekeeping and preventive maintenance procedures have reduced the amount of wood and petroleum waste on the plant grounds.

The efforts of introducing the plant managers to cell design have reduced the amount of work in process and developed a more flexible manufacturing system. It is now possible to efficiently produce smaller batch sizes and change to new parts more quickly. According to the plant manager, these changes have increased production per employee by 20 percent. As a result of the technical assistance provided in this area, Marplex managers and employees also have become more knowledgeable of flow-through manufacturing principles, manufacturing cell design, and techniques to reduce changeover time.

The consensus from the managers involved with this portion of the project was that their experience with cellular layout and the information gained from the Valued Added Manufacturing (VAM) workshop provided a useful model for developing future improvements in their production systems. They commented that there was a need to continue to improve their production processes and systems to meet their customers' needs.

Benefits to the Firm

The technical assistance projects conducted by NWMOC staff have increased Marplex's capacity to respond to its customers' requests and needs while reducing its annual costs by $120,000. This assistance helped the company complete its storm-water pollution plan, as required. Implementation of this plan will reduce the potential of pollution problems in a geographic area noted for its recreation and tourism.

Cost savings related to eliminating the need for a full-time person to work with the infeed system and reducing maintenance time by 12 hours per week would total about $3,000 per month. This is a conservative estimate of savings since it does not include the time that would be lost when a breakdown occurred in the infeed system. Also, it does not include the cost of parts to repair the quadrant feeder and conveyor, which were eliminated from the system. In addition, these changes reduced electrical consumption and eliminated the preventive maintenance costs for these components.

The common feeling among steering committee members was that the complementary improvements to the production system and the new system put in place had provided them with more flexibility. One of the managers commented that, "We are now able to respond to our customers' requests more quickly." Another manager commented, "We are doing more with less." The plant manager estimated these savings amounted to $7,000 per month, reflecting less downtime and a more efficient production system that required less overtime and work in process.

The increased capabilities developed at Marplex will help to preserve the 125 jobs at the company. In a town of 8000 people this company has an important impact on the local economy.

Other Improvements. Follow-up interviews at Marplex, conducted approximately 3 months after the completion of the project, revealed several more general outcomes and impacts of their interaction with NWMOC staff, impacts that cut across the several technical assistance projects conducted in the plant and the specific changes implemented. These capabilities are more general and continue to influence the work of plant managers and employees. Introduction to the VAM approach has created a new paradigm for their decision-making. One of the plant managers commented that, "As I view the processes we use, I try to determine the value added by each one." Another noted that he uses the VAM principles when he designs or redesigns processes and systems. Similarly, steering committee members at the plant reported in the follow-up interview session that, "VAM has provided us with a new way of looking at our manufacturing systems and processes. We are now constantly looking at the value added by the activities we do and the changes we consider."

It was also apparent that the problem-solving approach used by NWMOC staff had an impact. One of the managers commented that, "One of the valuable skills I learned was the systematic problem-solving process used by the NWMOC staff members." In addition, Marplex staff members found that CAD and visual problem-solving to be useful tools. Some staff members also noted that their work with the NWMOC project manager had increased their awareness of informational and technical resources available to them in their company.

Competing Explanations

There were no other external consultants or resource people working with the areas covered by the technical assistance activities at Marplex during the time of the NWMOC project. There were no competing explanations for the impacts that resulted from the changes in Plants 3 and 4. These changes reduced annual costs by $120,000 per year. A mechanical design company did the final design and installation of the dust collector system.

An automated pallet nailing machine had been purchased prior to the time of the NWMOC interaction with Marplex. This decision aroused the need for revisions in the layout of part of Plant 1. The NWMOC project manager assisted with the new layout.

A certified consulting firm was hired to finalize the storm-water pollution prevention plan. However, this firm was retained after the NWMOC project had been completed. The data and draft plan compiled by NWMOC staff were used by the consulting firm.

Case Study

RCF SEALS & COUPLINGS, INC.

Vidalia, Georgia

GEORGIA MANUFACTURING EXTENSION ALLIANCE

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

RCF Seals and Couplings, Inc.

RCF Seals and Couplings, Inc. (RCF), manufactures rubber-coated fabric seals and couplings for the aerospace industry. Its 32-employee facility is located in Vidalia, Georgia, a rural community approximately 3 hours southeast of Atlanta.

Product Requires New Testing Procedure

RCF developed a rubber-coated seal for its customer, Learjet, Inc. The seals were to be used on a critical system[1] on the new Learjet 45 (a 10-passenger business jet). The seal was designed as a state-of-the-art economical solution[2] to an ongoing industry problem—the ability to withstand sustained temperatures of over 800 °F. Cost pressures and declining demand (see Table 1) have prompted aerospace industry manufacturers to produce more fuel-efficient aircraft capable of operating at higher temperatures. Low-cost materials that can withstand high temperatures are thus desirable.

Table 1
Declining Aerospace Industry Value of Shipments: 1988 vs. 1994*
(Values in billions of dollars)

Value of Shipments	1988	1994
Current dollars	107.7	101.7
Constant (1987) dollars	106.7	92.3

*Years were chosen to exclude the Gulf War build-up.
Source: U.S. Department of Commerce, International Trade Administration, U.S. Industrial Outlook, 1994, pp. 20-1.

RCF faced a problem in locating testing facilities capable of subjecting the seal to 800 ° F heat and complex mechanical motions simulating air service. A cold-temperature (-65 °F) test was also required. The seal had to be tested before the Learjet 45 could meet its first flight date in 1995, so time was critical.

RCF's president explained the crucial nature of the test: "The importance of this test to my company is clear—a test of our material at the required temperatures will document the use of our high-temperature elastomeric material. More importantly, however, is that other companies are eagerly awaiting these results."[3]

RCF does not conduct its own testing. Learjet also lacked the specialized resources to test this application of RCF's seals. RCF was unable to find any commercial sources that could perform the high-temperature test at a sustainable price and within Learjet's required time frame.

Georgia Manufacturing Extension Alliance Helps Find Testing Facilities

RCF contacted the local regional office of the Georgia Manufacturing Extension Alliance (GMEA) in Dublin, Georgia, for help.[4] The GMEA regional office manager, who had worked with RCF on several previous projects,[5] called the GMEA Technology Linkages Office in Atlanta on February 23, 1995, to assist in identifying testing facilities.[6]

After discussing the problem with RCF, the GMEA Technology Linkages Office manager contacted the Direct Assistance Program at the Oak Ridge National Laboratory in Oak Ridge, Tennessee.[7] The GMEA Technology Linkages Office manager had recently toured several Oak Ridge laboratories, including the High Temperature Materials Laboratory (HTML). The Technology Linkages Office manager inquired about the use of the laboratory for testing, and formulated a request for technical assistance on behalf of RCF.

The Oak Ridge Direct Assistance Program arranged for a scientist from HTML to be assigned to the project. The Technology Linkages Office manager, accompanied by representatives of RCF and Learjet, visited the HTML on April 21, 1995, to review the preliminary test apparatus and make suggestions. RCF qualified for 80 hours of free technical assistance and, because Learjet was present at the site visit, an additional 80 hours of assistance.[8] The GMEA Technology Linkages Office provided 20 hours of assistance, also at no charge to RCF.

Actual testing began the following week. In all, five separate tests were performed as part of an iterative process of redesigning and testing, during which RCF made changes in the seal and couplings mechanism. Earlier versions of RCF's seal failed two of the high-temperature tests.[9]

Oak Ridge could perform the high-temperature portion of the test, but not the cold-temperature portion. In parallel with the Oak Ridge activities, the GMEA Technology Linkages Office manager contacted the Warner Robins Air Logistics Center (WRALC), the closest Federal lab facility to RCF. WRALC had the facilities to perform the cold-temperature test, but because the timetable was accelerated and WRALC had other work in process, the Technology Linkages Office arranged to have Oak Ridge ship their test fixturing to WRALC for use in the WRALC environmental chamber. This action gave Learjet more confidence in the test and, although WRALC ultimately had to design and fabricate its own test fixture, having the Oak Ridge design concept helped make it possible for WRALC to perform the test.[10]

Seal Passes Tests and RCF Learns about the Federal Laboratory System

RCF's seal successfully passed high- and cold-temperature tests in August. The tests proved for the first time that this type of seal can withstand sustained temperatures of as high as 800 °F and as low as -65 °F and complex mechanical motions simulating two years of service.[11]

Another benefit was that RCF learned about the federal laboratory system. In September 1995, RCF submitted a proposal to the HTML User Center Program, which enables companies to work directly with the laboratory on non-proprietary research at no cost. Through this program, RCF is testing a seal design that uses less exact connections that are more economical to manufacture. RCF is also exploring the possibility of licensing the testing apparatus from Oak Ridge, which would give the firm in-house testing capability. Table 2 summarizes these changes in RCF's capabilities.

Learjet engineers, previously unaware of industry assistance programs, were impressed with the assistance provided by GMEA and Oak Ridge. As a follow-up, the GMEA Technology Linkages

Office manager gave Learjet contacts at similar programs near its headquarters—the Mid-America MTC and the DOE-Allied Signal Kansas City, Missouri, facility.[12]

Test Results Help RCF Generate New Sales

RCF has received orders from Learjet and other commercial and military aircraft manufacturers since the test. Sikorsky Helicopters and Pratt & Whitney of Canada have placed or plan to place orders.[13] RCF has already booked an additional $2 million in orders over the next 2 years,[14] and is planning to introduce applications for the seal in other industries, beginning with petrochemicals.[15] The company believes that it could potentially generate $50 million in sales over the life of the seal.

Export Sales, New Jobs for Vidalia

Although only about 2 percent of RCF's sales currently go to firms outside the United States, RCF has given sales presentations at the invitation of foreign aerospace contractors. The company believes that export sales could equal domestic sales over the life of the seal.

RCF's 32-employee workforce reflects the addition of 10 new jobs in 1995. New employees were added in the areas of office support, production, inspection, document and production control, machining, and engineering. Some of these positions represented a new "middle management" layer for the company. Table 3 summarizes sales and job impacts.

Table 2

Changes in RCF Product Development Testing Capabilities

Before Assistance	• No systematic proof of high-temperature and mechanical motion tolerance • No in-house testing capabilities • Never used the federal laboratories
After Assistance	• Independent testing data shows the seal materials can withstand temperatures ranging from -65 °F to +800 °F and motions simulating two years of service • RCF and customer learned how to use the federal laboratories • Potential to license testing equipment which would provide in-house testing capability

Table 3

Changes in RCF Sales and Employment after Assistance

	Sales	Jobs
Before Assistance	• $1.2 million in 1994 • Roughly 95 percent of sales to customers in the commercial, domestic aerospace industry	• 22 employees • Top managers performed supervisory functions
After Assistance	• Additional $2 million booked over 2 years • Potential sales in petrochemical industry • Additional expert sales	• 10 new jobs, all functions • Added new "middle management" layer

No Alternative Explanations

Although RCF had the product and customer in hand, the lack of test data for FAA certification was a barrier to closing the sale. The small company did not have the resources to conduct or pay for testing. Learjet did not know of a suitable testing source, and RCF's networking efforts did not produce an appropriate testing laboratory.

In all of RCF's efforts to find a testing facility, the federal laboratories did not surface as a resource. "Nobody had ever heard of using the Federal labs," said RCF's president.[16] The GMEA Technology Linkages Office manager concurred, saying "anyone off the street would have a tough time knowing the right people to contact."[17] WRALC, for example, had never provided this type of technical assistance to small Georgia manufacturers prior to this project.

In a letter to Martin Marietta Energy Systems, now Lockhead Martin Energy Systems, Inc., which referenced the GMEA Technology Linkages Office manager and Oak Ridge personnel, RCF's president stated, "None of this would have been possible without the considerable help of the gentlemen named above."[18]

CHRONOLOGY OF SERVICES

April 1994	• RCF sites facility in region, meets GMEA regional office manager. GMEA provides plant layout assistance.
June 1994	• RCF requested information on locating a vendor to retrofit its compression molds. GMEA regional manager contacted six companies which likely had technical capabilities, but only two had scheduling capacity.
July 1994	• The regional manager used the Georgia Tech Metalworking Job Shop Directory to identify all vendors within a two-hour radius of Vidalia. Information was mailed to RCF.
September 1994	• RCF requested information on monatomic hydrogen, which GMEA's Information and Data Services group supplied.
November 1994	• RCF requested information about sources for fatigue failure stress analysis of seal component. GMEA regional manager contacts another regional office manager who provides four suggestions for testing sources, both university and private-sector sources.
December 1994	• GMEA regional office manager continued to search for fatigue failure stress analysis of seal component, spending several hours contacting GMEA regional offices and Georgia Tech departments. He located a researcher in Georgia Tech Research Institute's Aerospace Laboratory. The researcher analyzed the design and suggested design modifications in a technical report, "Assessment of RCF Coupling Failures," December 16, 1994. The project involved 30 total hours of effort.
Early January 1995	• RCF called GMEA regional manager, requesting assistance for recruiting Georgia Tech alumni and students for employment. Information was relayed back to RCF.
End of January 1995	• RCF called GMEA regional manager. Its major customer, Learjet, Inc., required RCF to test seals used in cabin pressurization, a new application for RCF's product. This test, which called for low- and high-temperature exposure, had to be passed before Learjet's new passenger aircraft could start its FAA certification trials. GMEA manager requested written requirements of test lab.
February 23, 1995	• GMEA regional manager contacted the GMEA Technology Linkages Office (TLO) manager. TLO manager started working with Warner Robins Air Logistics Center (WRALC).
Early March 1995	• GMEA regional manager and TLO manager met to discuss urgency of test and how to expedite actions involving WRALC.
March 7, 1995	• Because WRALC could only perform the cold-temperature portion of the test, TLO submitted request to Oak Ridge National Laboratory to perform high-temperature testing.
Mid March 1995	• TLO manager contacted Oak Ridge Direct Assistance Program about utilizing its High Temperature Materials Laboratory (HTML). Several conference calls occurred.

- **Early April 1995** — RCF qualified for technical assistance. The Oak Ridge HTML scientist set up the testing apparatus.
- **Mid April 1995** — GMEA TLO manager set up visit with the Oak Ridge HTML scientist and representatives from RCF and Learjet to review the preliminary test results.
- **April 21, 1995** — TLO manager and representatives from RCF and Learjet visited Oak Ridge HTML, reviewed the progress, and made suggestions to modify the test apparatus. TLO gave RCF's customer contacts at another MEP center (the Mid-America Manufacturing Technology Center) and federal laboratory (Department of Energy—Allied Signal facility) near Learjet's headquarters.
- **End of April 1995** — Oak Ridge HTML fabricated special test fixtures that could be used in the WRALC cold-temperature test environmental chamber. HTML began testing series.
- **May 1995** — RCF continued to make design changes.
- **June 12, 1995** — Oak Ridge submitted preliminary summary of Test 3 and Test 4 data to RCF showing failure of early versions of the seal.
- **June 30, 1995** — RCF shipped seal and testing fixture to WRALC for further testing.
- **August 1995** — Preliminary report material from Oak Ridge submitted on August 7 showed seals passed high-temperature Test 5 (consisting of more than 4000 10-minute thermal cycles operating 24 hours a day over a four-week period, simulating two years of service). Final report from WRALC submitted on August 14 showed seals passed cold-temperature test (consisting of 50,000 motion cycles of 100 cycles a minute operating a few hours a day over a five-day period).
- **September 1995** — RCF joined Oak Ridge HTML User Center Program. Assistance featured in "Spotlight on Technology," NASA Southeast Regional Technology Transfer Center & Southeast Regional Federal Laboratory Consortium, September/October 1995, Vol. 4, No. 5, p. 5.
- **October 7, 1995** — Learjet 45 launched its business jet's first flight.
- **October 17, 1996** — RCF requested testing to qualify its seals in petroleum industry applications. The TLO manager sent a request to the Georgia Tech Research Institute. The reply the following day recommended Georgia Tech and external researchers provide this testing assistance and identified the need for specific test parameters which RCF is finalizing.

ENDNOTES

1. The aircraft's bleed air system, which powers anti-icing, environmental control, and other systems by diverting high-pressure air from the engine's exhaust system.
2. Interview with the president of RCF Seals and Couplings, Inc., November 20, 1995, who indicated that, although other products could perform the same function, they were at least four times as expensive.
3. Letter from RCF to Martin Marietta Energy Systems, contractor to Oak Ridge National Laboratory, May 13, 1995.
4. The Georgia Manufacturing Extension Alliance (GMEA) is a NIST/MEP-sponsored partnership of four organizations that provide an integrated model for delivering management and technical assistance to small- and medium-sized manufactures in Georgia. The partnership, led by the Georgia Institute of Technology (Georgia Tech) Economic Development Institute (EDI), includes the University of Georgia Small Business Development Centers (SBDC), the state Department of Technical and Adult Education's (DTAE) Quick Start program, and Georgia Power Company's Technology Applications Center (TAC).
5. GMEA worked with RCF on several projects in 1994 prior to this request:plant layout assistance, metalworking vendor information, and stress analysis of coupling fatigue failure. For more information about the stress analysis, see "Assessment of RCF Coupling Failures," Preston R. Bates, Georgia Tech Research Institute, December 16, 1994.
6. The Technology Linkages Office coordinates access to resources for problems requiring specialized or expert assistance, particularly from university faculty and the federal laboratories.
7. Technical assistance request, March 7, 1995. Initially, Warner Robins Air Logistics Center (WRALC) was contacted, but could not perform the high-temperature test.
8. The assistance was funded under the Oak Ridge Technical Asistance Program and the National Machine Tool Partnership (now discontinued).
9. Martin Marietta Energy Systams, Inc., review of RCF/Learjet Project, internal correspondence, June 12, 1995.
10. Warner Robins Air Logistics Center, "RCF Seal Cold Temperature Qualification Test," August 14, 1995. The WRALC engineers used the Oak Ridge design concept even though they could not use the actual fixture. The test was provided to GMEA as an experiment in providing this type of assistance.
11. Ibid. See Oak Ridge National Laboratory, Metals and Ceramics Division, High Temperature Materials Laboratory, August 7, 1995 (fax of test results). The fifth Oak Ridge HTML high-temperature test, which RCF's seal passed, consisted of more than 4000 thermal cycles lasting 10 minutes each and operating 24 hours a day over a four-week period. The WRALC cold-temperature test consisted of 50,000 motion cycles (100 cycles a minute) operating a few hours a day over a 5-day period.
12. Interview, GMEA Technology Linkages Office manager, June 23, 1995.
13. Letter from RCF to Martin Marietta Energy Systems, contractor to Oak Ridge National Laboratory, May 13, 1995.
14. See Supplementary Materials, Production Log, November 20, 1995, which illustrates how RCF tracks customer bookings. The company currently has orders to supply approximately $90,000 in seals for five Learjet airplanes per year. The remaining 55 percent of sales represents bookings with Sikorsky, Pratt & Whitney, and other customers.

15. RCF asked the GMEA Technology Linkages Office manager for assistance in identifying petrochemicals industry resources. See internal memorandum, GMEA Technology Linkages Office, request for test of elastomer composite compatibility with various organic materials typically used in a petroleum plant, October 18, 1995.
16. Interview with President of RCF Seals and Couplings, Inc;, November 20, 1995.
17. Interview with manager of GMEA Technology Linkages Office, October 26, 1995.
18. Letter from RCF to Martin Marietta Energy Systems, which manages Oak Ridge National Laboratory, May 13, 1995.

Case Study

SHAKESPEARE ELECTRONICS AND FIBERGLASS

Newberry, South Carolina

SOUTHEAST MANUFACTURING TECHNOLOGY

CENTER

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Shakespeare Electronics and Fiberglass

Shakespeare Electronics and Fiberglass (Shakespeare) has been revolutionizing the fishing industry since 1897 when William Shakespeare, Jr. created and patented the level wind fishing reel. Fifty years later, Shakespeare introduced the first fiberglass "wonder" rod maintaining its reputation as a pioneer in the fishing industry. By 1960, the Shakespeare was one of the leaders in fiberglass development in the United States and expanded into a variety of fiberglass products including: radio-military antennas, pool cues, archery equipment, hammer handles, ski poles, fishing rods, and light poles. Shakespeare relocated to Newberry, South Carolina, in 1965 and was formed exclusively for the manufacture and sale of fiberglass antennas.

The Newberry location has 355 employees and not only manufactures communication antennas, but uses the same technology to produce fiberglass poles for the fishing industry and fiberglass light poles.

Today, Shakespeare is an internationally recognized organization. The firm is ranked in the top ten of the domestic fishing tackle market with recent growth averaging 10—15 percent. Its competitors include Zebco, Berkley/Fenwick, Johnson/Mitchell, and Penn and Silstar. The customer base for Shakespeare's line of products includes mass merchants, distributors, and retailers such as Walmart, Target, Sports Authority, Kmart, and Sportmart.

The Nature of the Technical Assistance

The Challenge. The original *Ugly Stik®* was a 20-year-old design. Based on the number of fishing license requests over the past 10 years, the fishing industry was not a growing market. Competition had increased, with labor intensive processes moving overseas.

With strong competition and a stagnant market, Shakespeare wanted to develop the next generation fishing rod, extending the product life cycle of the current *Ugly Stik®*. In January 1994, Shakespeare set out to design its next innovative product—a fishing rod that was thinner, lighter, more sensitive, and that retained its strength.

In the past, Shakespeare had used trial-anderror processes to develop prototypes in the design of new products. However, tooling for new product design was time consuming and costly—as much as $10,000 per design which, with various materials and configurations, could add up to $150,000 for a single style product. Wanting minimal timeto-market, Shakespeare required a different approach to product development. Shakespeare contacted the Southeast Manufacturing Technology Center (SMTC) at the University of South Carolina (USC) for assistance in duplicating its design concepts with computer simulation design and modeling tools.

The Solution. SMTC at USC's expertise is in advanced technology applications. Through computer simulation, senior specialists Dr. Roger Hsiao and Dr. Curtis Rhodes sought to duplicate the dynamic characteristics of the existing *Ugly Stik®* and incorporate various combinations of composites. Phase 1 of the project was to develop a computer simulation tool to analytically predict the static and dynamic behavior of the fishing rod. Phase 2 was to design and fabricate prototype rods to verify computer simulation. SMTC participated in Shakespeare's weekly and biweekly design meetings, and acted as a validation and verification resource throughout the application of this advanced technology. William Banczak, Shakespeare director of research, states, "This project represented a great collaboration effort and SMTC provided us the technology resources that we lacked internally." The computer simulation tool was able to predict the sensitivity, weight, and functionality of the new design without the extended prototype lead times and costs associated with trial-and-error methods.

In July 1994, prototypes were reviewed at the American Sportfishing Association (ASA) Exposition. Wide acceptance of the product led to an expansion of the original project. Phase 3 was added to include design tooling and cut schedules for nine spinning rods, four casting rods, and six fly rods, with the goal of introducing the products at the July 1995 ASA show. With a new critical time element and expanded project objectives, manufacturing had to begin in January 1995 to be ready for the show.

New Manufacturing Processes Raise Performance Levels

The introduction of a computer simulation tool to Shakespeare's new product development and introduction process helped the company design its products more efficiently and accurately with reduced time-to-market. Shakespeare met its design and production schedules for the ASA show, where it introduced the *Ugly Stik® Lite Series*. Of the new, exotic materials considered for the new product, ultimately, a graphite-and-glass combination was determined as optimal. In addition, alternative processes and cutting schedules were considered to help optimize the product design. The product weight was reduced an average of 10-15 percent, while the diameter was reduced by 25-30 percent. Along with this reduction in product material and weight, the product strength was maintained, and in some cases, improved. The new *Ugly Stik® Lite Series* was enthusiastically received at the ASA conference and, more importantly, by consumers. Within the first five months of new product introduction, 90 percent of the original annual forecast was produced. With an estimated product life of 10 years, total projected sales of this new product is expected to be $7,700,000. "Interestingly, one of our competitors also introduced a new *'lite'* product at the ASA show. If we hadn't met our time-to-market and design objectives, we could have lost 10 percent of our total business to the competitor," states Banczak.

The new technology implemented for this product design process accelerated Shakespeare's ability to introduce new products. Shakespeare was once again seen as an innovator in fiberglass-reinforced products. Its reputation and positioning in the market was solidified by this

new product introduction. Finally, the project not only facilitated Shakespeare's ability to introduce a new and innovative product, but also helped it gain a better understanding generally of its product and process.

Public Benefits

The product life cycle of the original *Ugly Stik®*—the number one selling rod for 19 years—was extended with the introduction of a lighter, thinner, and more sensitive rod. The positive response by the market is visible in Shakespeare's increased sales. In addition, the success of the *Ugly Stik®* has caused Shakespeare to maintain its work force level, with 20 percent directly impacted based on this new product introduction.

Alternative Explanations

SMTC was one of many participants in Shakespeare's project team for this new product development. Also included in the project team was Monroe Lindler, a former Shakespeare employee and now a consultant, who had extensive experience in designing rods using traditional methods. The combination of the resources contributed to the success of this project. However, no other activities were underway that would have resulted in the improved product design with the reduced development costs and time-to-market.

CHRONOLOGY OF SERVICES

January 1994	• Shakespeare identified need for a new, improved product.
July 1994	• Prototypes ready for American Sportfishing Association (ASA) Exposition.
September 1994	• Service contract signed for expanded project—"lite" series.
September 1994	• Project development begins.
January 1995	• Product series completed.
January 1995	• Product begins.
July 1995	• New products introduced at the ASA show.

Case Study

SHERWOOD PLASTICS, INC.

Fostoria, Ohio

LAKE ERIE MANUFACTURING EXTENSION PARTNERSHIP

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Sherwood Plastics, Inc.

After 25 years with Diamond Shamrock, Inc., Mark Jones retired from the company and began searching for a company of his own to buy. He considered more than 100 firms with annual sales between $3 million and $10 million before selecting Sherwood Plastics. Mr. Jones had reasoned that the major weakness in Sherwood's profile could, in fact, offer an opportunity: Sherwood was totally dependent on the heavy duty (class 8) trucking industry for orders. With the help of a silent partner, a basic strategy evolved to purchase the business and diversify the product line and targeted markets.

Sherwood is a rotational molder. Rotational plastic molding is an excellent alternative manufacturing process, for low-volume production of hollow plastic components with complex and varied shapes. It is superior to other molding techniques in the crucial areas of low tooling cost, quick change-over time, minimum economical lot sizes, and part size. Roto-molded products often provide a lightweight replacement for more commonly used materials. A combination of improved plastics technology with advances in mold construction, resins, and machinery has prompted the use of a variety of plastics. Versatility of the process allows for product sizes ranging from small ear syringes of plastisol to large 22,000 gallon vessels of polyethylene. The roto molding process has three stages:

1. Ground polyethylene (90 percent of Sherwood's volume) is added to a split aluminum mold of the part at the load/unload station.

2. The roto-molding machine then rotates the mold into a oven where it is heated to 550 ° F - 600 ° F degrees Fahrenheit for about 12 minutes to 15 minutes while rotating on two axes at low speed.

3. The mold is indexed to the cooling station, where water or air is used to cool it to approximately room temperature. Secondary operations include flash trimming, cut outs, and drilling and assembly of purchased components, after the parts are allowed to cool.

Mr. Jones and his partner purchased Sherwood Plastics in 1989 and Mr. Jones became its president. The company, which had operated as a family-run business since its founding in 1966, lacked budgets, sales staff, business and marketing plans, engineering capability, and quality assurance. The new president went to work in sales. With a new sales force in place, he was confident he could use his marketing skills to expand the product offering beyond the rotomolded plastic ductwork being manufactured for the trucking industry. The new owners soon were considering manufacturing components for

other markets, such as health care (dentist chairs and raised toilet seat parts), boating (tanks), home entertainment (outdoor speaker boxes), mailboxes, and environmental products in addition to its trucking industry-related products.

As planned, the business diversified its product offerings. It introduced a new product reflecting value-added operations —a completely indestructible mailbox with the customer literature packed in individual cardboard boxes. Combining value-added fabrication and assembly operations with product-line diversification led to 50 percent growth in 1992 and an additional 25 percent in 1993. Another basic strategy was to develop a quick-change job shop capability to react to opportunities in any of the new markets. Yet, when new orders began to materialize and Mr. Jones could justify expansion, he was unsure how to proceed. Having no manufacturing engineers on staff, he realized he needed to find a trustworthy source for economical, cost-effective assistance.

Linking Up with the Lake Erie MEP

Mr. Jones was aware of the Edison Polymer Innovation Corporation (EPIC), a State of Ohio Thomas Edison Center, which provides technical resources to help polymer-related companies. His first call to EPIC led to a referral to the Cleveland Advanced Manufacturing Program (CAMP), another Thomas Edison Center dedicated to helping small manufacturers become more competitive. CAMP was formed in 1984 and, in 1989, expanded by creating a subsidiary called the Great Lakes Manufacturing Technology Center (GLMTC). GLMTC was one of the first three National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP) Manufacturing Technology Centers (MTC). In 1992, CAMP formed a partnership with the Edison Industrial Systems Center (EISC)—a third Edison Center of which the Lake Erie Manufacturing Extension Partnership (LEMEP) is a subsidiary. Since Sherwood is located within LEMEP's service region, LEMEP assumed lead responsibility for assisting the firm.

Technical Assistance Provided

LEMEP received Mr. Jones' request in late May 1993. The request led to a plant visit on May 27, 1993. Dick Hanson, LEMEP's field engineer, presented the center's capabilities while developing a feel for the business and for Mr. Jones' vision of Sherwood's next 5 years. Within two weeks, LEMEP presented a proposal, which drew in part on resources available at GLMTC.

Facilities Expansion Project. The ball was in motion. By July, LEMEP had developed a footprint/concept for the company's expansion, with construction to begin in October.

The 33,000-square-foot expansion doubled the facility's size. It provided space for in-process cooling for additional molding equipment, consolidated off-site storage, and incorporated just-in-time manufacturing concepts. The new manufacturing layout completely rearranged Sherwood's factory.

Benchmarking Projects. In November 1993, Mr. Jones agreed with Mr. Hanson to benchmark his business. Together they completed a *QuickView Plus Benchmarking*, funded through LEMEP. The resulting profile report benchmarked Sherwood Plastics against established national and international standards, and offered diagnostic guidance and recommendations useful in outlining a continuous improvement plan for the company. At LEMEP, the field engineer is responsible for facilitating the QuickView evaluation and providing value-added input based on an analysis

of the QuickView report and on the knowledge gained in a detailed plant tour.

In February 1994, on Mr. Hanson's recommendation, Mr. Jones agreed to complete a *Performance Benchmarking in Plastics Processing* assessment. Developed by the NIST Midwest Manufacturing Technology Center (MMTC) in Ann Arbor, Michigan, the benchmarking tool was made available to Sherwood through the LEMEP/ MMTC partnership.

Information Systems Project. On March 1, 1994, Mr. Jones requested help in developing a 12—18 month plan for Sherwood's information systems. Mr. Hanson and Mike Rastatter, GLMTC's technical program manager, visited Sherwood and met with Mr. Jones and Kelly Vekas, Sherwood's secretary and treasurer. Mr. Rastatter presented a plan and proposal outlining a process and engineering cost estimate for a new *Information Systems Acquisition and Implementation Plan.* Mr. Jones chose to fund the effort using internal resources and a more cost-effective external consultant.

Labor-Management Relations. In March 1994, Sherwood was confronted with a successful effort to organize the hourly workforce, during which Mr. Hanson provided Sherwood with information on the following:

- Work In Northeast Ohio Council, a non-profit organization whose mission is to help business, labor, government, and academia improve the economic climate and competitive position of companies and organizations.

- Schumaker, Loop and Kendrick of Toledo, and Tim Mc Carthy, labor attorneys.

- Labor Management Citizens Committee at the University on Toledo, and Joe Tomossie, executive director.

Space Utilization and Material Flow Projects. In June 1995, Mr. Jones called Mr. Hanson requesting assistance. A large potential order had recently been identified that could require an additional roto-molding machine. Sherwood management was also concerned about manufacturing costs and identifying productivity improvement opportunities (e.g., the use of a computer numerically controlled (CNC) machine for de-burring/hole drilling of high-volume repetitive parts and the use of time standards in the molding operations). A proposal was prepared, and Mr. Jones elected to fund a project to evaluate space utilization and material flow in the new building. Project deliverables included:
1) three to five alternative layouts, and associated material flow diagrams; and
2) computer-aided design (CAD) drawings for placement and operation of an additional roto-molding machine. LEMEP hired a private contractor to successfully perform these tasks.

Mold Defect Project. In the same time frame, Sherwood was experiencing quality problems with one of its molds. In response, Mr. Hanson arranged for assistance through the National Center for Tooling and Precision Components (NCTPC) in Toledo, Ohio. NCTPC provided Sherwood with a coordinate measuring machine analysis of the mold to resolve the quality problem—a cost-effective solution.

Waste Reduction Initiative. In October 1995, Mr. Hanson contacted Mr. Jones to discuss the Waste Reduction Technical Assistance Program funded by a grant from the Ohio Environmental Education Fund (OEEF) and the Ohio Department of Development. Mr. Jones expressed an interest in knowing more about waste reduction. LEMEP proposed a waste assessment of the South Countyline facility to identify waste streams and opportunities for cost savings in waste reduction. For a $600 investment, Sherwood received 10 practical profit improvement opportunities with a projected total annual savings of $416,750. Detailed suggestions were given for the following:

- The purchase and installation of equipment to permit purchasing resin in pellet form for reduction to 35 mesh, as well as reduction of scrap to 35 mesh for reuse within the operation.

- A 10 percent reduction in electric demand, a 10 psi reduction in compressed air pressure, and the purchase of natural gas on the Spot Market.

Seven projects are realistic and planned for implementation in the short term.

Ongoing Initiatives

The latest vision LEMEP and Sherwood are creating together is the use of employee empowerment teams. Sherwood is experiencing excessive employee turnover, and the market dictates a low wage structure in a business involving a relatively labor-intensive process. In July 1995, Mr. Jones was receptive to establishing employee teams using the Labor Management Citizens Committee (LMCC) located at the University of Toledo in Toledo, Ohio. LMCC's mission is to guide unionized companies through a process of setting up employee teams. The process begins with an assessment to determine whether the union and company leadership are ready to accept the idea of delegating power to the work force. If ready, a steering committee is formed and trained through offsite formal training and by visiting plants with successfully functioning employee involvement teams. The steering committee, consisting of four management and four hourly representatives, then has the responsibility of setting up factory teams to address problems of productivity improvement and successful company progression. Mr. Jones is favorably evaluating the opportunity.

Changes in Manufacturing Capacity and Practices

The projects that Mr. Jones, Sherwood's president, and Mr. Hanson, LEMEP's field engineer, have undertaken have helped improve both Sherwood's overall manufacturing capability and many of its specific manufacturing practices.

Changes in General Capabilities. Sherwood now has:

- A manufacturing capacity to produce at the $6-8 million sales volume level.

- A diversified product-market mix.

- An information system capable of handling the increased customer base.

- A quality system with demonstrated consistency.

- A manufacturing process capable of producing at the rate of $70,000 in sales per employee, up from approximately $50,000 prior to LEMEP assistance.

New Business Practices. The construction of the new facility allowed implementation of many of the new business practices LEMEP presented to Mr. Jones.

- Over 1.5 million pounds of high-density powdered or ground polyethylene per year is purchased and stored in the bulk storage system recommended by the project. Sherwood is saving $45,000 a year in raw material costs alone.

- Material handling costs are down. For example, the concept of a high-bay area for staging in-process material was incorporated for a cost-effective price, and is now providing invaluable storage space while presenting customers with an excellent impression of an organized facility.

- The high-bay storage facilitates proper curing of in-process material after molding and before finishing operations. This process step was missing in the old practices. Quality has also improved.

- Process operations have been consolidated in the new facility, reducing material handling and the cost of transportation to and from an offsite warehouse.

- The use of work cell concepts has vastly improved work force productivity.

- Although Sherwood chose an alternative product, the detailed information system discussion and proposal were helpful in guiding the internal project.

- Sherwood is working on preparations for full QS-9000 registration using internal resources—also a 1993 QuickView Plus Benchmarking recommendation.

Business Benefits to the Company

Sherwood has benefitted from the changed business performance. From 1993, the year LEMEP assistance began, to 1995, sales increased from $3.5 million to $6 million, a sales volume that would have been unattainable had the firm continued to operate in its older, smaller, and less productive facility. The $2.5 million increase in sales at an estimated 25 percent incremental contribution margin yields $625,000 in incremental income. Added to this benefit are reduced material costs and a $540,000 gain from greater employee productivity, for a total annualized cost benefit of $1.2 million (see Table

1, Summary of Annual Cost Benefits). That total represents 20 percent of sales—the difference between a break-even or loss business and a profitable business on a world-class track. Its former operating performance led to Sherwood's sale. The improved operating performance will lead to continued growth.

Moreover, Sherwood anticipates an additional $107,750 in savings from seven of the 10 LEMEP-proposed waste reduction projects. (See Table 2, Summary of Waste Reduction Savings). The company projects these seven initiatives will cost approximately $102,000; thus, the payback on this investment will be less than a year.

Other tangible (though unquantified) benefits have resulted from Sherwood's enhanced product quality. In 1991, a major customer, Navistar International Transportation Corporation, gave Sherwood four months to prepare for a quality audit. At that time, the new quality control manager had just begun to build a plan. Sherwood barely passed Navistar's initial audit. Now, Sherwood proudly presents its quality system and record. More recently, Temple Products Company of Cleveland switched suppliers because of a quality problem associated with its boat gas tanks. Since 1994, when Sherwood took over the business, Temple has not had a quality problem. Sherwood's growing reputation for quality production augurs well for its future growth potential.

Public Benefits

The public benefits are basic. There are 86 people employed in a town hit hard by defense downsizing. At least 20 employees are associated with the expansion project, and the business is now successfully operating in competitive markets during a period when external market conditions have caused a decline in the trucking market. Furthermore, Sherwood has been able to maintain its employment level and continue to contribute to the community of Fostoria, Ohio.

In January 1994, Mr. Jones and Sherwood Plastics were recognized for their contribution in the Entrepreneur of the Year program: "We hereby recognize Sherwood Plastics for their exceptional commitment to the economic development effort of the Fostoria area."

The combined efforts of companies like Sherwood have led to a situation in which the 1996 rate of unemployment in the Fostoria area is in the three to four percent range—a nice problem to have!

Table 1

Summary of Annual Cost Benefits

Year	Sales	Employees	Sales/Employee	Comment/Annual Cost Benefit
1989	$3.0 MM			
1990				
1991	$1.87 MM			
1992	$2.81 MM			50% Sales increase
1993	$3.51 MM	66	$53,000	25% Sales increase
1994				$45,000 in bulk purchase of raw materials
1995	$6.0 MM	86	$70,000	$540,000 in employee productivity
1995				$625,000 in incremental contribution margin
1995				$1,210,000 in realized annual benefit

Producing $6 million in sales at a productivity of $53,000 in sales per employee would require 113 people instead of the 86 employees on staff in 1995. The 27-employee savings at an estimated annual cost of $20,000 each would yield $540,000 in productivity savings to the company.

Table 2

Summary of Waste Reduction Savings

Cost Element	Process Change	Cost Savings	Capital Cost
Electricity	• Control demand—reduce 10%	$2,500*	$960
Powder weighup	• Replace paper bags	$1,400*	$750
Powder weighup	• Avoid paper bag loss/replacement	$350*	included above
Labor	• Operate roto-mold machine with one person	$273,000	$250,000
Resin	• Buy pellets and pulverize	$52,500*	$100,000
Recycle scrap	• Pulverize scrap and reuse in process	$45,000*	included above
Natural gas	• Reduce oven heat loss with redesign	$9,000	$15,000
Labor	• Oven redesign to simplify load and unload	$27,000	included above
Natural gas	• Purchase gas in bulk on the spot market	$5,000*	$300
Compressed air	• Reduce shop air pressure	$1,000*	$100
	• Total	$416,750	$367,110
	• Total savings judged real Sherwood	**$107,750***	**$102,110***

* The asterisk identifies those projects judged realistic by Mr. Jones.

Table 3

Summary of Benefits to Sherwood

Implemented projects savings	$1,210,000.00
To be implemented	$107,750.00
TOTAL	1,317,750.00
Cost to Sherwood for LEMEP services for all projects	$20,950.00
Benefit to Sherwood for every dollar invested in LEMEP	$63.51

CHRONOLOGY OF SERVICES

		Cost to Sherwood
June 10, 1993	• The Facility Expansion Project	$14,800
November 5, 1993	• QuickView Plus Benchmarking	$0
August 10, 1995	• Additional Rotational Molding Machine Project	$5,550
January 25, 1996	• Waste Reduction Report	$600
	Total Cost to Sherwood for All Projects	**$20,950**

Case Study

TIMBERLYNE CABINET COMPANY

Angier, North Carolina

NORTH CAROLINA MANUFACTURING

EXTENSION PROJECT

an affiliate of the Manufacturing Extension Partnership

November 1996

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CASE STUDY

Timberlyne Cabinet Company

Timberlyne Cabinet Company produces frameless wood cabinets at its plant in Angier, North Carolina, just south of Raleigh. The plant, which opened in 1986, currently employs 32 people and has annual sales of about $5.5 million. Over the past several years, Timberlyne has automated its operations, thereby reducing the number of employees required to produce its products.

The company's market niche is in frameless cabinets with a high-quality, durable finish. Its main customers are small kitchen and bath dealers along the East Coast. Timberlyne's market reaches from Pennsylvania to Georgia, with the largest customer base residing in North Carolina, South Carolina, and Virginia. In the past, customers have included large general contractors; however, the company has shifted to the kitchen and bath dealers' market because it is a more stable source of business.

Timberlyne has differentiated its products in different ways over the years. Because frameless cabinets use less lumber than framed cabinets, the company has, in the past, emphasized environmental concerns, along with cost, as a marketing strategy. More recently, however, Timberlyne has emphasized its superior finish. The ultraviolet (UV) curing process used on its products produces a very durable finish that is resistant to abrasion, water, steam, chemicals, and stains, and also is washable. Timberlyne is one of three wood cabinet companies in the United States using sprayed, UV-cured finishes on its cabinets and the only wood cabinet company using pigmented sprayed, UV-cured finishes. Thus, the UV curing process is an important part of Timberlyne's competitive strategy.

By automating and heavily marketing their unique product, Timberlyne expects to expand their market sufficiently to open a new plant. Timberlyne currently operates a single plant in Angier, North Carolina, and plans to open a plant in Kentucky. Initially, this plant will produce about the same volume as the North Carolina plant; Timberlyne eventually plans to expand operations at the Kentucky plant to five times the current volume of the North Carolina plant. The Kentucky plant will serve many potential customers in Kentucky and Tennessee, and, in addition, be but a 1-day trip by truck from most customers in New England, New York, and Boston.

Within the 37,000 square foot plant, the employees of Timberlyne perform, among other functions, the following processes at the workstations:

- Cut 5x8 sheets of medium density fiberboard (MDF) into appropriate sizes
- Machine and drill the MDF
- Edge, bore, and sand the MDF

- Spray paint some items in a conventional spray paint booth

- Load parts into the Venjakob UV spraying and curing line, which reads the size of the parts, cleans and deionizes the parts, sprays the coating onto the parts, bakes them in a hot water oven, and finally cures the finish under UV lights

- Assemble and pack cabinets

Technical Assistance Areas

Timberlyne Cabinet Company called NCMEP for help with four different technical issues:

- Inconsistent finish quality on products processed in the spray paint booth

- Unacceptable performance of UV-curable coatings used in its UV curing process

- Unacceptable properties and cost of its MDF supply

- Environmental permitting issues related to airbag return air

Table 1 summarizes these issues and their implications for the plant's performance.

Spray Paint Booth. Timberlyne was having trouble achieving an even application of paint in its spray paint booth. A great deal of dust and overspray was settling on the pieces being sprayed, causing lumps and bumps in the finish. Almost every piece painted in the booth had to be resprayed (sometimes four or five times). The problem had been recurring for approximately 6 months.

Because the spray booth was used only for low-production items (large-volume products were painted in the Venjakob coating/curing line), the problem had not been solved, although the plant was still operating.

The problem with the spray paint booth was becoming a serious nuisance and eroding the plant's productivity. Because many of these products had to be reworked so many times, significant capital was tied up in work-in-process inventory. These low-production items were taking a long time to complete successfully, and the inconsistent finish and long delays resulted in the loss of several customers.

UV Curing Process. In February 1995, Timberlyne purchased a Venjakob coating/curing line from European Woodworking Machinery, an Austrian firm. This equipment, costing $500,000, used a UV curing process, which employs a UV light to cure a coating onto a surface. However, Timberlyne was unsuccessful in getting the UV process to work properly. It was using a low-VOC coating that did not properly adhere to the surface. Even after a number of visits by the coating vendors, no solution emerged.

While trying to solve this problem, Timberlyne used the new spraying and curing line with its high-VOC (acid-cured) coatings. Because the equipment and plant layout were designed to work with the low-VOC, UV-curable coatings, the use of high-VOC coatings caused indoor air quality problems and discomfort for workers. This use also caused failure of belts on the paint spraying line. The belts normally last for two years, but Timberlyne had used five belts in less than one year.

Table 1

Description of Technical Issues and Their Implications

Technical Issue	Brief Description of Problem	Impact of Problem
1. Spray Paint Booth	Items painted in spray booth had bumps and lumps	Almost 100 percent of product had to be reworked, sometimes four to five times Work-in-process inventory piled up Inconsistent finish quality Delay in order turnaround
2. UV Curing Process	Could not find a coating that would work properly with the UV curing process; used high-VOC coatings with equipment designed for low -VOC coatings	Machinery did not work properly Belts wore out Indoor air problems Inconsistent finish quality
3. MDF Properties suddenly changed	Old supplier of MDF material cost formulation and primer would not adhere properly; new supplier more than three times as expensive	Use of Canadian supplier tripled raw Use of original supplier required adding a sizing, sealer, and two sanding steps to process
4. Airbag Return Air	Airbag return air could not be vented to outside without environmental permit; if vented to inside in summer, caused severe worker discomfort due to heat	Title V permit could cost at least $5,000, plus administrative costs Exploring feasibility of cooling airbag return air prior to venting to inside, which would require expensive changes to ventilation system

Two of the belts were damaged by the installation crew, so at least two belts, at $4,000 each, were lost due to use of acid-cured coatings with machinery designed for use with UV-curable coatings.

Because Timberlyne experimented with a variety of UV coatings, they expect to have trouble in the future matching colors that were applied to cabinets during this period. Finish quality was also inconsistent and customers complained.

Timberlyne had virtually given up on the low-VOC process. It was aware of another company that tried to implement a similar technology a few years ago and failed. Assuming it had also failed to successfully implement this technology, Timberlyne asked NCMEP engineers for help in reconfiguring the plant to more efficiently use the high-VOC coating process, given the existing equipment.

MDF Properties. Timberlyne also was having a problem with the MDF used in the construction of its cabinets. Before calling NCMEP, Timberlyne found that its original U.S. supplier of MDF changed its formulation, and the new formula caused problems with primer adhesion. Timberlyne had to change its production process from a two-step process (apply primer, then topcoat) to a six-step process (apply sizing, sand, apply sealer, sand, apply primer, apply topcoat). These extra steps cost a great deal of labor time. In addition, the nitrocellulose sizing, which was not used in conjunction with the old MDF formulation, added to the materials cost per cabinet.

Timberlyne's initial solution to this problem was to find another MDF supplier. Its new source was a Canadian firm, and although the MDF functioned properly, the price was greater than three times that of MDF purchased from the original supplier. This short-term solution cost Timberlyne a great deal, so the company hoped NCMEP could uncover an alternative source of MDF that met both cost and performance requirements.

Airbag Return Air. Timberlyne had a problem with venting airbag return air within the plant, which affected the comfort and productivity of workers. This exhaust air, which is first filtered to remove wood particles, is very warm and, when vented inside the plant on hot summer days, caused a severe heat problem. The plant manager had been told that, to legally exhaust the air to the outside, he needed an expensive Title V air permit. Although the filing fee for the permit is $5,000, the plant manager believed that other costs, including the time required to develop the permit, keep records, and accompany inspectors, would result in a far greater total cost. The plant manager wanted to find an alternative to filing for the permit and asked the NCMEP engineers to help find a way to cool the exhaust air so that it could be vented to the inside without causing a problem for workers.

Technical Assistance Provided

Jim Jensen, the Timberlyne plant manager, first contacted NCMEP on August 2, 1995. NCMEP completed the assistance by September 14, 1995. The Chronology of Services shows the timeline of interactions between NCMEP and Timberlyne Cabinet Company.

Mr. Jensen called the NCMEP because he had a positive experience with the North Carolina Industrial Extension Service (NCIES)—the parent organization of the NCMEP—a few years earlier. At that time, Timberlyne was expanding its plant. The NCIES conducted a plant layout project, and Mr. Jensen was very satisfied with the assistance he received. This positive experience led Mr. Jensen to call Bob Edwards, NCMEP's director, in connection with the spray paint booth problem on August 2. Mr. Edwards talked with Mr. Jensen and started the assistance process.

A series of contacts followed. Mr. Edwards assigned the case to Joseph Davis, one of NCMEP's extension specialists. Mr. Davis returned Mr. Jensen's call and gathered more details about his technical problems. Also, Mr. Davis initiated background literature searches. Mr. Edwards put together a site visit team, which included Mr. Edwards, Mr. Davis, Steve Walker, and Rich Clinton. Mr. Walker is a furniture engineering specialist, and Mr. Clinton is a manufacturing specialist. The team conducted the site visit on August 9.

Mr. Walker and Sholeh Azar, an environmental permitting expert, conducted a follow-up site visit to address the airbag return air issue.

Mr. Davis coordinated the follow-up activities. He and other members of the site visit team researched Timberlyne's technical problems and discussed proposed solutions. To address the third problem, the MDF properties, the NCMEP consulted both the Polymers Extension Program (PEP) and the NASA Marshall Space Flight Center. On September 14, Mr. Davis sent a letter to Richard Gambill, Timberlyne's president, summarizing the solutions to each problem and inviting requests for further assistance. NCMEP provided assistance and advice that contributed to solutions to these problems.

Timberlyne also initiated a number of activities that directly contributed to solving the problems, both in conjunction with and independently of the advice provided by NCMEP.

Spray Paint Booth Modifications. Timberlyne's problems in its spray paint booth had been recurring for 6 months. It had tried a number of different duct work configurations, but could not seem to effect a satisfactory solution. The company also worried that reducing the air volume too much would violate OSHA regulations. During their visit to the plant, the NCMEP engineers watched as the spray paint booth was operating. They noticed two problems. First, Timberlyne's employees could not properly regulate the positive airflow required in the paint booth. In particular, the air curtain they were using to maintain this positive air pressure was too strong, causing a draft in the booth. Second, filters in the rear of the booth clogged with paint over time and made it difficult to maintain the required positive air flow in the paint booth, compounding the problem.

To solve these problems, NCMEP agents recommended a baffle on the inlet air to regulate the positive air flow and a diffuser to make the air flow less direct. To prevent swirling and backspray within the booth, which caused rough paint application, NCMEP agents recommended extending the exhaust plenum in the back of the paint booth to cover its entire length. Timberlyne's own maintenance staff performed this repair for about $45 in materials and about 8 hours of labor.

Search for Suitable UV-Coating Recommended. Timberlyne decided to try the UV-curable coatable process after attending the National Kitchen and Bath show in New Orleans in April 1995. Timberlyne invested $500,000 in the UV-curable line and was fairly committed to the process because of its reputation for superior performance. However, after all of the problems it had trying to find an appropriate coating, Timberlyne was at the point of deciding to retrofit the plant, convinced that it should give up on ultraviolet-cured coatings. After talking with NCMEP, however, the company continued to work with vendors to find a suitable coating and eventually was successful.

Before conducting a site visit, Mr. Davis contacted Carolina Power & Light Electrotechnologies for information on the UV curing process and initiated a literature search on UV coatings. During the August 9 site visit, he provided Mr. Jensen, the plant manager, with two journal articles about UV curing and the names of three potential suppliers of appropriate coatings. He later sent two other journal articles explaining the UV curing process and its benefits.

After touring the plant, conducting some background research, and talking with Mr. Jensen, the NCMEP agents advised him that the best solution was to continue to search for a suitable UV coating rather than to retrofit the plant to use high-VOC coatings. Because the spraying equipment and ventilation system were originally designed and installed for low-VOC UV coatings, it would be prohibitively expensive to retrofit the facility for high-VOC coatings. Mr. Davis encouraged Mr. Jensen to continue to work with various coatings vendors to find a suitable formulation. In doing so, he emphasized the benefits of the UV technology, including the virtual elimination of high-VOC solvents from the coating process.

Problems Resolved with MDF Board. NCMEP manager Mr. Edwards conducted several activities to investigate this problem. First, he sent a sample of the failing MDF to the PEP in Charlotte for a review. The PEP determined that the problem was outside their expertise. Next, he initiated technical assistance from NASA through Byard Houck of the NCIES and Sammy Nabors of the NASA Marshall Space Flight Center. NASA tested samples of the MDF board and identified the problem. They arranged a three-way conference call between Mr. Jensen, Mr. Davis, and Roger Black of the NASA Technology Utilization Office. They explained to Mr. Jensen that the problem was with the board formulation and invited the vendor, Georgia-Pacific, to consult with them about fixing the problem with the board. Armed with the technical information he received from NCMEP, Mr. Jensen continued to ask Georgia-Pacific to make the required changes until the problem was resolved. Georgia-Pacific did deliver a better product. Although Georgia Pacific may have eventually switched the formula without MEP intervention, the advice provided by the MEP hastened this process.

Application for Less Expensive Permit Advised. After researching the issues, Mr. Azar and Mr. Walker advised Mr. Jensen that he could apply for a federally enforceable permit with a provision allowing for seasonal discharge, rather than applying for a Title V permit. This permit can be filed for a fee of $250, rather than the $5,000 fee required for the Title V permit, and requires less administration and recordkeeping than a Title V permit. This permit eliminated the need to install a cooling device in the ventilation system. Timberlyne opted to apply for the less expensive permit.

Changed Manufacturing Practices and Related Outcomes

Timberlyne made several changes in its manufacturing practice as a result of NCMEP's assistance. Table 2 summarizes these changes and

the resulting changes in capability, technical performance, and business outcomes. First, Timberlyne reconfigured the spray paint booth as NCMEP suggested, resulting in the most dramatic change to their manufacturing practice—the virtual elimination of rework from the spray paint booth. Second, Timberlyne is now using a UV coating that provides a quality finish with the UV-curable process. Third, the company is using a less expensive source of MDF that does not require the six-step process described above. Finally, Timberlyne is not venting any airbag return air to the inside, except in winter, and has not had to file for a Title V air quality permit.

Improved Spray Paint Booth Process. As shown in Table 2, NCMEP's recommendations to Timberlyne regarding the spray paint booth allowed Timberlyne to paint without paint swirling, dust, and backspray. This change led to a dramatically improved technical performance: with doubling of throughput in the spray paint booth and the elimination of rework. Before correcting the problem, Timberlyne workers could paint approximately 30 doors per hour and had to paint every door about four times; now that number is up to 62.5 doors per hour, repainting only 10 percent of the doors one time. According to company estimates, Timberlyne saves $1,157.33 per 1000 doors in labor costs. Annually, Timberlyne paints 75,000 doors in the spray booth for an annual savings of $86,800. By reducing rework, Timberlyne also reduced its materials costs (no quantitative estimate was developed for the materials savings).

Commitment to UV Curing Process. As a result of using the UV-curable coatings, Timberlyne has experienced the following outcomes:

- Improvement of product quality leading to reduction of customer reject rates, expanded customer base, and an enhanced reputation
- Elimination of indoor air problems
- Reduction of belt-changing intervals
- Improvement of on-time delivery
- Avoidance of additional capital costs for retrofitting the plant to work with high-VOC coatings
- Reduction in labor and materials costs
- Elimination of solvents from the coating process for parts painted on the UV- curable line, leading to significantly improved environmental performance

It was possible to quantify the savings resulting from some of these factors.

Materials Savings. UV coatings have a much higher transfer efficiency than high-VOC coatings (more pigment reaches the product); thus, much less material is used. UV coatings have an 80-percent transfer efficiency, while VOC coatings have a 25-percent transfer efficiency. Furthermore, the UV-curable coatings do not require a primer. Thus, before Timberlyne began to use the UV-curable coating, each part had

Table 2

Summary of Changes in Practices and Outcomes

Technical Issue	NCMEP Recommendation/ Action	Change in Practice	Change in Capability	Change in Technical Performance	Change in Business Performance
Spray Paint Booth	Recommendations: extend exhaust plenum; install baffle and diffuser.	Reconfigured paint booth according to NCMEP's recommendations.	Ability to paint without swirling, dust, and backspray.	Doubled throughout in the spray paint booth from 30 doors per hour to 62.5 doors per hour; changed rework from four coats per door to 11 coats per door.	■ Annual labor savings of $86,800 ■ Reduction in materials costs
UV Curing Process	Recommendation: continue to search for a UV-curable coating that will work; NCMEP located possible suppliers.	Discontinued plans to use high VOC coatings; successfully continued search for UV coating that performs well.	Better understanding of UV process led to better communication with vendor and successful search.	UV-curing process resulted in: ■ Higher-quality finish ■ Elimination of indoor air problems ■ Elimination of belt problems ■ Avoided scrapping the low VOC line ■ Elimination of solvents from coating process on UV line ■ Eliminated 228,500 lbs of annual VOC emissions	■ Materials savings of $177,200 per year ■ Labor savings of $56,000 per year ■ Belt savings of $22,000 per year ■ Reduction of customer reject rates ■ Increased on-time delivery
MDF Properties	Recommendation: continue to work with Georgia-Pacific to find formula with appropriate fiberboard qualities.	Communicated with Georgia-Pacific and described problems.	Successfully convinced Georgia-Pacific to change formulation—now has MDF that works.	Can use lower-cost fiberboard while eliminating extra preparation steps.	Annual savings of $101,120 in fiberboard
Airbag Return Air	Apply for special federally enforceable, flexible air permit.	Venting airbag return air to outside in summer.	Greater knowledge of permitting system, allowing a reduction in cost of compliance.	Elimination of worker discomfort problem in summer without cost of Title V permit; avoided capital spending for cooling mechanism.	Savings of $4,750 for permit, plus other associated costs; OR avoided capital costs of $8,000 to $10,000 to cool air (plus the energy costs of running it).

to be painted seven times (primer front and back; three topcoats on the front; two topcoats on the back); with the UV-curable coatings, only five coats are required.Thus, the increase in transfer efficiency and the elimination of the primer coat more than make up for the increased per-gallon cost of the UV coating. Annual savings are about $177,200.

Savings on Belts. Timberlyne replaced the belts on the UV spraying/finishing line five times in 6 months. These belts, which cost $4,000, normally last 2 years. Two of the belts were damaged by the equipment installation crew, but the rest were from stress related to using acid-curable coatings. Total annual savings are $22,000.

Labor Costs Savings. Mr. Jensen has reduced his labor costs a great deal since purchasing the UV-curable line. However, most of these labor savings are not attributable to the NCMEP because they would have occurred regardless of whether the automated UV spraying/curing line was used with UV-curable or with high-VOC paint. However, once the finishing line was working properly with the UV-curable coatings, Timberlyne did decrease the number of finishers required from four to one. The remaining person working the UV-curable line earns a higher salary because this job requires greater skill and knowledge of the equipment. The annual labor savings total $56,000.

Elimination of Solvents. A typical acid-cured catalyzed top coating has a VOC content of about 5.1 pounds per gallon. Before switching to UV-curable coatings, which contain no VOC solvents and are applied as 100 percent solids, Timberlyne was using about 896 gallons of acid-cured coatings per week. By switching to UV-curable coatings, Timberlyne has eliminated emissions of 4570 pounds of VOCs per week, or 228,500 pounds per year.

More Cost-Effective MDF Supplier. We can calculate the savings due to finding an MDF supplier that meets Timberlyne's needs in two ways. The first (and simplest) way is to calculate the difference in the materials cost between the high-priced Canadian producer and the U.S. producer they are currently using. Savings from using the lower-priced board total $101,120.

The second way to calculate these savings would be to consider the labor and materials costs required to make the original MDF (from the original U.S. supplier) perform properly. To use the original MDF, Timberlyne had to use a six-step method: size, sand, seal, sand, prime, and topcoat. Now that they have solved the problem and found a board that performs properly, they only need to prime and topcoat. Although we could calculate the labor cost of these additional steps, Timberlyne originally solved the problem by finding the Canadian source of MDF that functioned properly. Therefore, we attribute to NCMEP's assistance only the difference in cost between the Canadian MDF and the lower-cost MDF, both of which worked properly.

Airbag Return Air Problem Resolved. There are two ways to calculate business outcomes from solving the airbag return air problem. First, the permit filed by Timberlyne cost $4,750 less than the Title V permit it thought was necessary. Second,

is through avoided capital cost. Mr. Jensen said he was opposed to filing for a Title V permit and was planning, instead, to install a cooling system that he estimated would have cost between $8,000 and $10,000.

Public Benefits

Several public benefits from this assistance are worth noting:

- By using the UV-curable coatings, Timberlyne has reduced its VOC emissions by about 228,500 pounds per year

- Timberlyne has improved working conditions due to:
  - decreased VOC emissions
  - reduction of time workers spend in the paint booth
  - reduced heat in the plant during summer

- The average wage of employees working on the painting line is higher, because it is a higher skill job

- By using a U.S. rather than a Canadian source of MDF, Timberlyne is indirectly contributing to the prosperity of the U.S. wood products industry

Competing Explanations

This section describes alternative explanations for changes in outcomes that occurred after NCMEP's assistance.

Outside Expert Intervention. Without NCMEP, Timberlyne may have continued to try unsuccessful approaches to solving the spray paint booth problem. Eventually, it may have found a contractor or outside expert to identify the problem and develop a solution. Estimating how long this might have taken without NCMEP's assistance is difficult.

Similarly, before getting NCMEP's advice, Timberlyne planned to continue venting the airbag return air to the inside because it did not want to obtain a Title V permit. It had planned to solve the problem by cooling the air within the ventilation system. Timberlyne may have learned of the special permit from another source, but they may have learned of it too late—after already making improvements to its ventilation system. These changes may have cost Timberlyne not only the initial investment required to install the ventilation system, but also the additional energy required to run it.

Timberlyne's Commitment to UV Curing Process. Timberlyne decided to adopt the UV process early in 1995. Although fairly certain that it wanted to use the UV process, Timberlyne could not find the material that would work with it. Jim Jensen stated that, in time, the company may have found an appropriate coating, even without the information NCMEP provided, but had reached a point at which it was questioning the decision and was prepared to retrofit the plant for the other type of coating. By convincing Timberlyne to continue to pursue a UV coating, MEP prevented the company from retrofitting the plant, which would have been costly and would have had negative environmental implications.

Likelihood of Reformulated MDF. Georgia-Pacific may have developed the reformulated MDF board anyway, even without the input of the NCMEP

and NASA, although it is unclear whether problems would have been resolved as quickly. NCMEP provided technical information that encouraged Jim Jensen to continue working with Georgia-Pacific to test samples and resolve the problem. The reformulation process may have taken longer without this assistance. Furthermore, Timberlyne may not have known when Georgia-Pacific changed the formulation and may have continued to use the Canadian supplier unnecessarily.

Summary

Timberlyne Cabinet Company contacted the NCMEP to ask for assistance in solving problems with four processes: its spray paint booth, its UV curing process, the properties of its MDF board, and its airbag return air. NCMEP was able to help Timberlyne solve each of these problems.

Timberlyne has changed a number of its practices as a result of NCMEP's assistance. The company has reconfigured its paint booth according to NCMEP's recommendations; it has discontinued its plans to return to high-VOC coatings, because it found a coating that works with their UV curing process. Timberlyne discontinued using the expensive Canadian MDF supplier because Georgia-Pacific has developed an MDF that solves the company's adhesion problems. Finally, it is venting airbag return air to the outside in the summer.

Some of the technical and business outcomes of these actions are quantifiable. Annual savings totaled $443,120 for all outcomes. Timberlyne also enjoyed a one-time savings of $4,750 for its air permit. In addition, the company has eliminated 228,500 pounds of VOC emissions per year.

Other, nonquantifiable impacts include:

- A higher-quality finish on its cabinets
- Elimination of indoor air problems
- An improvement in reputation with its customers

CHRONOLOGY OF SERVICES

August 2, 1995	• Jim Jensen, plant manager, called Bob Edwards to request assistance.
August 3, 1995	• Joe Davis returned call to get a better idea of the problem; made appointment for site visit on August 9, 1995.
August 7, 1995	• Joe Davis contacted CP&L Electrotechnologies for information on the UV curing process. Initiated a literature search on UV coatings.
August 8, 1995	• Joe Davis prepared for site visit.
August 9, 1995	• Site visit, included Bob Edwards, Joe Davis, Rich Clinton, and Steve Walker.
August 22, 1995	• Steve Walker and Sholeh Azar visited Timberlyne to consult about the environmental issues.
August 29, 1995	• After some research and analysis, Joe Davis called Jim Jensen to explain UV and painting corrections.
August 31, 1995	• After PEP and NASA review, Joe Davis called Jim Jensen to advise on MDF solution.
September 11, 1995	• Rich Clinton developed notes about the environmental solution, talking with Sholeh Azar.
September 14, 1995	• Joe Davis sent a letter to Richard Gambill summarizing the solutions and inviting requests for future assistance.

Case Study

TRIDENT, INC.

Brookfield, Connecticut

CONN/STEP

an affiliate of the Manufacturing Extension Partnership

November 1996

Prepared by:

Tab Wilkins

CONNSTEP

New Britain, Conn.

CASE STUDY

Trident, Inc.

Trident, Inc. (Trident) designs, manufactures, and markets impulse ink jet subsystems, including printheads, inks and other consumables, to the industrial market. Trident's proprietary products are used for a variety of printing applications which require high speed, good printing quality, durable equipment, and the ability to change the printed text or pattern frequently. Trident's Ultrajet printing subsystems are marketed worldwide, primarily through more than 70 original equipment manufacturer (OEM) customers who integrate them into computer-controlled, application specific products that are then sold to end-users. Its contracts with OEM customers also provide for ongoing sales by Trident of consumables, consisting principally of inks and printing subsystem components. Trident's net sales have grown from $6.4 million for the 12 months ending December 31, 1991, to $17.3 million for the 12 months ending September 30, 1995 ("Fiscal 1995").

The Market

The largest application for Trident's products is carton coding, which involves printing directly onto shipping cartons. Carton coding systems incorporating Trident's products allow end-users to print any combination of high-quality text, bar codes, and graphics directly onto blank cartons as they move down an assembly or production line. Trident's products permit frequent changes, even carton by carton, of this information. This capability eliminates the need to maintain a substantial inventory of preprinted cartons or labels, reduces production time and costs, and allows frequent changeovers between products. Other current industrial applications for Trident's products include check coding, addressing and business forms imprinting, postal bar coding, stamp cancellation, and garment pattern plotting.

Problem Identification and CONN/STEP Assistance

The company was originally contacted in August, 1994 by a "cold call" from Dale Detrick, the regional Field Engineer. At the time, it was clear that the company was very aggressive in developing its product and product technologies.

Trident's in-house engineer oversaw day-to-day operations, but could not also meet the demands to expand and accommodate Trident's high growth. Two issues were initially identified with the Field Engineer: 1) modifying plant layout to accommodate expansion needs in ink production; and 2) introducing work cells to improve workflow on the printer head line.

Plant Layout Project. Trident's growth had forced it to develop increased production capability within its current buildings and floor space. The company had two buildings, one housing its R&D operations and the other its manufacturing operations. Trident thought that their growth could

be accommodated by moving ink production, along with some associated departments, into the R&D building. These relocated manufacturing processes would take over space freed by reduced inventory and improved workflow.

The CONN/STEP Field Engineer's role was to help Trident locate the external expertise needed to conduct the study and develop a new layout. In March 1995, Trident elected to work with Fraunhofer Institute, one of several consultants Mr. Detrick identified and interviewed along with Trident.

Introducing Work Cells. A second project, initiated in April 1995, sought to expand the use of work cells throughout the ink jet printer head line. In January 1995, the company had experimented on its own by setting up one work cell in the Calibration Test Department. Working with four people in a cell environment, Trident was able to cut the calibration time from 4 weeks to 1 day.

With the success of one cell so evident, Trident wanted to adapt the cell idea across all parts of the department. However, the company's limited engineering staff did not have the skills or time to demonstrate the new technique to shop floor employees, educate them in its operation, or develop their "buy-in" to the change. Successfully accomplishing these tasks was essential to expanding the experiment to the three other calibration cells.

CONN/STEP again helped to locate appropriate outside experts who could work with Trident and their employees in setting up the additional cells, and, more importantly, understanding the benefits of this approach. Trident selected Value Added Associates to assist with operationalizing the new cells, and, ultimately, switching the company from a "batch" processing mode to a "one piece" flow mode in the calibration department.

The company, in concert with adoption of the work cells, is implementing an increased pay scale based on job certification. As workers increase the number of jobs they are certified to work within a cell, their pay increases accordingly.

Changes in Practice

By August 1995, Fraunhofer developed a recommendation for a layout of ink production activities in the R&D building. Between $100—$125,000 was spent in renovations and capital equipment, and the new installation was completed and up and running in September 1995. The changes resulted in a new workflow, improved throughput, and reduced inventory.

The four work cells were up and running in the ink jet printer head department as of October 1995. Through the support of Value Added Associates, the employees began operating on a self-directed basis, setting up and running work cells on their own. Through the use of cells, Trident doubled the department's throughput rate. The project also has transferred the setup and management capabilities for work cells to the shop floor.

Resources Committed. The Field Engineer, through August 1995, had spent a total of 82 hours with the company working to identify consultants, helping Trident with their review process, and getting these two projects successfully completed. During this time, the Field Engineer had also been working with the company on a third project to help automate certain parts of the ink production line.

Between Fraunhofer and Value Added Associates, a total of approximately 300 hours in outside consulting expertise had been invested. The total cost of this outside expertise was $20,000.

Changes in Performance

The improved ink production layout allowed Trident to reduce its work in progress from $1.6 million to approximately $800,000 within 2 months. The cycle time for ink jet head printer calibration fell from four weeks to one day, further decreasing inventory needs. In addition, Trident is responding much more quickly to quality issues, correcting newly discovered quality problems in a day.

The company has been able to increase overall production by 25—35 percent a year without any significant addition of direct labor, thus improving Trident's position in the marketplace significantly. However, it has been adding engineering staff, six in the last year, to begin dealing with a number of technical issues in-house. CONN/STEP's role in the future is expected to focus on product development. This assistance will include helping Trident take advantage of federal laboratories, universities, and private resources in Connecticut.

Company-Initiated Improvements

Trident initiated the experiment into work cells on its own. Its staff had visited two companies that had introduced work cells, one on the recommendation of the CONN/STEP-associated consultant. Trident also understood that a plant layout and improved workflow could reduce their overall costs.

Without CONN/STEP, Trident might have introduced some of these actions on its own; however, by its own accounting, the company believes it would have been at least a year later. Additionally, it believes it would have made significant mistakes, mistakes which might have greatly extended this timeline and retarded the firm's growth.

Public Benefits

In the short-term, several construction jobs were created as the R&D facility was renovated, and new capital equipment purchased and installed, and, as noted, six longer-term engineering positions have been created. The substantial savings in production costs will allow the company to remain a strong competitor in the marketplace and to continue to meet their growth needs. Already, Trident's improved performance has generated additional corporate and income taxes, and its sound future prospects hold the promise of further increases.

Finally, the company's workers are upgrading their skills through the work cell pay certification process. The increase in skills has allowed workers to receive increased wages, while solidifying the company's reliance on their Connecticut workforce.

CHRONOLOGY OF SERVICES

August 1994	• Field Engineer Dale Detrick contacts Trident through a cold call.
January 1995	• Three plant layout consultants were interviewed and Fraunhofer selected to undertake the study.
January 1995	• Trident experiments with setting up one work cell in the Calibration Test Department.
March 1995	• Trident begins working with Value Added Associates for on-going support to help expand the use of work cells.
June 1995	• Initial plant layout recommendations made.
August 1995	• Renovations in new plant layout completed.
September 1995	• All new capital equipment installed and the new plant line up and running; initial savings recognized.
October 1995	• Expansion of work cells reaches four areas; a 30 percent reduction in inventory and a doubling in production achieved.
November 1995	• Beginning of additional work in product development assistance.

Case Study

WALKER SYSTEMS, INC.

Parkersburg, West Virginia

THE WEST VIRGINIA PARTNERSHIP
FOR INDUSTRIAL MODERNIZATION
an affiliate of the Manufacturing Extension Partnership

November 1996

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The West Virginia Partnership for
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CASE STUDY

Walker Systems, Inc.

Walker Systems, Inc. (WSI) is a nationally recognized manufacturer of power, lighting, electrical, and communications distribution systems for the non-residential construction industry. Located in Parkersburg, West Virginia, for 30 years, the company has approximately 300 employees.

Its current in-house focus is on traditional metal fabrication processes of moderate age. More than 75 percent of the company's business comes from the resale of its products through a national distribution system.

Operating in a 70-year-old facility, the company's manufacturing process was characterized by overly complicated work flow, excessively high inventory levels, and poor energy efficiency.

Industrial Extension Assistance

Quality Assessment. On June 7, 1993, WSI met the West Virginia Partnership for Industrial Modernization (WVPIM) when the regional extension engineer, Raymond Neupert, visited the company. During this initial site visit, Mr. Neupert presented the services offered by WVPIM to WSI's vice president of manufacturing, the quality assurance manager.

After the WSI management team evaluated the services offered by WVPIM, the company requested WVPIM's assistance in evaluating its quality assurance program. Mr. Neupert responded to this request by proposing that WVPIM evaluate the relative strengths and weaknesses of the company's program, assessing it against the criteria of the U.S. Department of Commerce's Malcolm Baldrige Award.

The WSI management team agreed to this proposal, and Mr. Neupert immediately began to assemble an appropriate WVPIM engineering team to perform the quality assessment.

The formal report on WSI's quality assessment, presented to the company on August 10, 1993, revealed some deficiencies in WSI's quality assurance program. The report also established a baseline against which WSI could measure subsequent improvements in its quality assurance program.

Production Process Assessment

WVPIM's successful analysis of WSI's Quality Assurance Program encouraged the company to request further assistance from WVPIM. The second request from WSI was for WVPIM to assist the company in the evaluation of its manufacturing capability.

In response to WSI's second request, Mr. Neupert proposed that WVPIM perform a Production Process Assessment at WSI's plant. Again, the WSI management team agreed to Mr. Neupert's proposal and he immediately began to assemble a second WVPIM engineering team to perform the Production Process Assessment for WSI.

At WSI's request, one of its manufacturing engineers was allowed to participate in the entire Production Process Assessment procedure. The purpose of involving a WSI engineer in the assessment process was to train him in the methodology associated with the performance of a Production Process Assessment.

The WVPIM engineering team worked diligently with WSI's staff to develop an indepth analysis of the company's manufacturing capability. The team used flow process charting, a standard industrial engineering technique, to track a subassembly manufactured by the company through its entire manufacturing process—from receipt of raw material to shipping.

The material flow process analysis, which the engineering team developed from the process flow charting technique, identified the WSI manufacturing activities that added value to sub-assembly versus those that added only cost.

WVPIM's formal report on WSI's production process assessment contained the following findings and recommendations.

WVPIM Findings

- WSI operates most of its production lines with the traditional batch-type manufacturing process.

- The sub-assembly was produced by a combination of the batch process and a work cell arrangement.

- Fork-lift trucks are used to transport work in process (WIP), and a manual system is used to track WIP on the production floor. Transportation of WIP and associated delays account for the major portion of the cost-adding activities performed in the surveyed production process.

- For the sub-assembly surveyed, thedistance the WIP traveled in the plant was considerable

WVPIM Recommendations

- Form employee teams to analyze the cost drivers (non-value-adding activities) in each product line produced at its facility.

- Follow the team's recommendations by implementing the actions necessary to reduce and eliminate cost drivers.

- Become knowledgeable of and apply the process flow and value-adding methodologies, because they are the primary tools for reducing WIP and cost drivers—delays, transports, etc.—in every function of the operation.

- Increase the number of work cells. Whenever possible, develop standard tooling and fixtures to facilitate quick change over in all production set-ups.

- Utilize the single minute exchange of dies (SMED) method to reduce set-up times.

Resulting Manufacturing Changes

After evaluating the proposed recommendations by the WVPIM engineering team, WSI decided to make the following operational changes in its manufacturing process:

- Establish a "flow-thru" manufacturing process by incorporating just-in-time (JIT) philosophies and focused factory techniques.
- Implement a pull-production system to keep inventories at the lowest possible level for most of its major products.
- Further implement cellular manufacturing practices by increasing the number of JIT cells.
- Install a real-time computerized job tracking and scheduling system to improve tracking of WIP movement into and out of manufacturing work cells.

Outcomes

When WSI's entire "flow-thru" manufacturing project was completed in 1995, the company had substantially improved its manufacturing capability. WSI is now realizing significant monetary benefits resulting from shortened production lead times, improved labor efficiency, and reductions in material handling and inventory costs. Revised work flow, work in process, scheduling, and inventory levels also have given WSI 40 percent more available plant floor space than it needs.

WSI is currently building a new facility in Williamstown, West Virginia. The benefits realized by faster cycle times and improved work flow were factored into the floor space design of the company's new facility.

Impacts to the Firm. WSI concluded in its evaluation that WVPIM assistance had an annual impact of $2,670,000 on its operations.

In WSI's evaluation of the impact of the services provided by WVPIM, the company stated the annual operational improvements by category as shown in Table 1.

Table 1

Operational Improvements

Operational Improvement	Financial Benefit
Overall Inventory Reduction	$2,000,000
Improvement in Sales	$400,000
Overall Productivity Improvement	$270,000

Conclusions

JIT philosophies, focused factory techniques, a pull inventory system, workcells, and an appropriate infrastructure were targeted by WSI in improving competitiveness. This initial improvement in competitiveness permitted the company to reduce the size of its new facility and increase its sales which, in turn, further elevated the company's competitiveness.

The connection made by WSI with WVPIM, the local Manufacturing Extension Partnership, was a vital link to services that the company can use in the future to move toward lasting competitiveness and world-class manufacturing status.

ron Industries Corporation • Braunstein Inc • Buerk Tool and Machine Company Inc. • Carver Pum
mpany • Century Aero Products International Inc. • Cheraw Yarn Mills Inc. • Conservation Allianc
c. • Custom Materials • D.J. Manufacturing Inc. • Extrusion Technology Inc. • Galileo Corporation
endale Technologies Corporation • Haas-Jordan Co. Inc. • Ithaca Peripherals Inc. • KD dids Inc. • Kint
astics Inc. • Luitpold Pharmaceuticals Inc. • Marplex Inc. • RCF Seals & Couplings Inc • Shakespear
ectronics & Fiberglass • Sherwood Plastics Inc • Timberlyne Cabinet Company • Trident Inc. • Walke
stems Inc. • Baron Industries Corporation • Braunstein Inc • Buerk Tool and Machine Company Inc.
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